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FRED R. LOW, *Editor*

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The Power Show

AGAIN Engineers' Week in New York is approaching, and a prominent feature of it will be the Power Show.

Of the old Mechanical Exposition power plant apparatus used to be an incident. Now it is important enough to have an annual show of its own at New York, one every two years at Chicago and others at times in different cities, not to mention the exhibits appended to numerous engineers' conventions.

Power, the muscle of this age of virility and accomplishment, is commencing to impress even the lay public. It is well that something of its poetry and history and tradition should be put on view.

The one-time simple process of burning coal, raising steam and pushing a crank around with it has developed into a complex operation in which processes formerly conducted manually are performed mechanically and often automatically, at pressures, temperatures, speeds and rates undreamed of by the former generation, and ingenious and delicate instruments guide the operator in its manipulation.

There is a lot more now to a power show than there could have been in the old days:

Not only the great variety of apparatus used in the production of steam and power, but that used for the measurement, distribution and application of these and the numerous other services that are supplied from the power plant.

As a comprehensive example of an installation involving these various services this issue carries a description of the power plant of the New Yorker Hotel, where, in addition to the purely motive function, the power plant will take care of the heating and ventilation, air conditioning, refrigeration, lighting, cooking, laundering, vacuum cleaning and all of the collateral services requiring heat as well as power.

It is expected that a large proportion of the power demand can be produced as a byproduct of the heating requirements.

F. R. Low

POWER SERVICES EVERYWHER-

TOO often power is narrowly pictured as electricity alone, whereas, in fact, its commercial forms are numerous. The power services under the direct supervision of the engineer in great buildings and industrial plants also include heating and ventilation, air conditioning, vertical transportation, steam for special uses, hot and cold water supply, fire protection, refrigeration, signal service and communication, vacuum for cleaning, compressed air, and so on. The *"plant,"* likewise, is not merely the boiler room and engine room, as popularly imagined, but the entire assemblage of equipment for the generation and application of these many services, and the maze of piping, wires, ducts, valves, meters and controls used in their transmission.

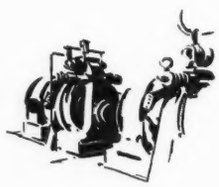
To see what an automobile looks like, one must look at an automobile. Piecemeal studies of engines, wheels, mudguards, and so on, are not enough. It is the same with power services. They may be artificially segregated on paper for purposes of detailed study, but no magic can keep them separate in actuality.

Here is an example: Electricity is produced by engines driven by steam. Steam is made from water heated by coal. Part of the final product, electricity, must be fed back to the boiler room to operate the fans, feed pumps and stokers or pulverizers used for steam production.

Wherever one looks, power services interlace in production, transmission and application. Electrically driven laundry machines are fed with water pumped by electricity and heated by steam. Heating, refrigeration, pumping and blown air combine in air conditioning. Pumping and refrigeration join in the ice-making process. Examples need not be multiplied to show that the power services are a *single* problem.

Failure to appreciate this essential unity spells bad design and bad management. These, in turn, inevitably lead to poor service and waste of money.

. . . And so *Power* dedicates this number to the proposition that all power services are one, and must be so considered in design and operation. As a symbol and an example New York's newest and largest hotel, the New Yorker, has been chosen. Under its single roof, towering forty-three stories above the streets of Manhattan, are to be found all power services. The elements of every power problem—whether in office building, theater, hospital or industrial plant—are there, and the opportunity is there to study power-service organization as a whole.



The train dispatcher in his tower is a wonder to the popular mind. How much more complex, in reality, is the task of dispatching unseen fluids through the power network of wires, piping and ducts to meet the unpredictable demands of thousands of individuals. Yet here, as in train dispatching, one mind at the top must direct the entire mechanism, else its various functions will clash and service will be disrupted.

Hence the need for an engineer of the highest type to operate the power-service plant. Lubrication and maintenance are among his many problems, but the traditional oil can and overalls symbolize him no more than a "bellhop's" uniform symbolizes a hotel manager. The engineer's job is essentially managerial. His problems are primarily those of applied economics and men. He must, it is true, know his machines; but real success depends on his ability to direct the work of others to produce the most perfect service at the lowest over-all cost.

A similar requirement must be faced in the design of any power-service installation. Piecemeal study of the problem may sometimes lead to the installa-

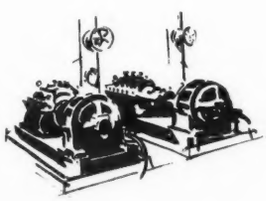
- - -WHAT THEY MEAN

tion of efficient individual units, but the plant as a whole will, more often than not, be just another horrible example of how to keep down profits.

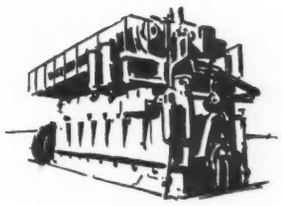
Heat balances within and between individual services are an essential part of any preliminary study of a power project. Even more important are the resulting economic balances. The observation that, in the last analysis, "it's all a matter of dollars and cents" is trite, but it is surely fundamental. "Engineering" shorn of the dollar mark may be good fun and a splendid outlet for mechanical ingenuity, but it should parade in another uniform.

The real complexity of the design problem, as applied to the power services of great buildings is only dimly appreciated by many. Glaring examples are to be found, for example, of plants where power generation and heating are viewed as two distinct problems. This is the most common and fundamental error, but failure to balance various loads, to evaluate power-factor correction in terms of the whole plant, and to consider how over-all dollar efficiency is affected by varying the thermal efficiency of individual units, is responsible for great losses.

The upshot of all this is that none but engineers of the highest capacity should be intrusted with the design and operation of power-service installations. In these men breadth of view is as important as experience and technical knowledge.



It is the hope of *Power's* editors that the related studies here presented will contribute to this broader view—that its readers will be better able to work back from the general to the specific in handling their own special power problems. Each plant is a new pattern, but always composed of the same basic elements. Ability to handle new combinations is acquired, in part, by studying those already in existence.



The New Yorker is such a pattern—one of unusual significance. New oil-engine applications are suggested by its yoking of Diesel to steam engines to improve reliability and summer heat balance. Its use of pulverized coal, with fly-ash separation, points to new installations in congested business districts. Waste heat recovery from oil engines is advanced by its example. In many details of units, arrangements and connections it will be of definite interest to engineers, although it must be recognized that each project is an individual problem. The studies of load curves and power costs illustrate established methods of approaching such problems and point to future refinements.

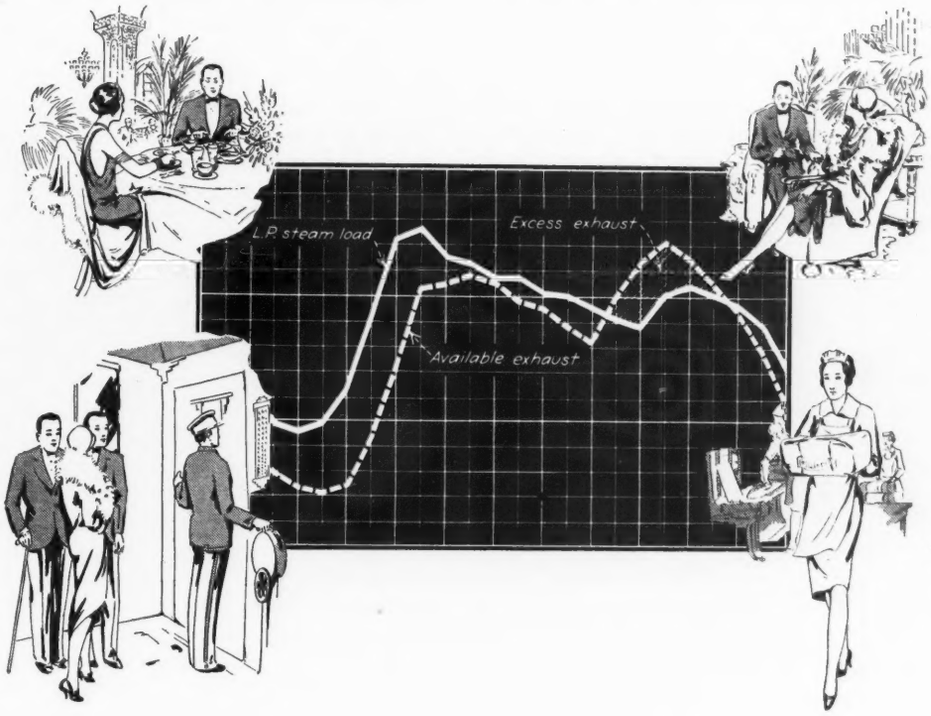
This number is a composite product. The views of various men are assembled and co-ordinated in its pages. For the basic information contained the editors have naturally leaned heavily upon the co-operation of the owners of the hotel and their engineers.

It is therefore fitting that *Power* should here record its indebtedness to those men, outside the editorial staff, who have made this presentation possible. In particular, acknowledgment should be made to Mack Kanner, president of the New Yorker Hotel Corporation, and to J. C. Sophian, general project manager, for their whole-hearted co-operation in arranging and putting through the general plan. Much credit is due H. W. Brooks, associated consulting engineer, and B. H. Pisow, engineer for the architects (Sugarman & Berger), who gave freely of their time and technical knowledge, and to Warren D. Lewis, operating chief engineer, who contributed from the broad experience he brings to the important job of operating the New Yorker plant.

THE NEW YORKER

New York's newest and largest hotel is an outstanding example of the power services in a modern building

FOOD . . . COMFORT . . . CONVENIENCE . . . CLEANLINESS



THE INGREDIENTS OF HEAT BALANCE

By P. W. Swain
Associate Editor of Power

Human Needs and Desires Are Behind *the load curves and heat-balance diagrams of the engineer. Using the New Yorker Hotel as example, this article interprets service demands in terms of load curves with comments on the process of tailoring the plant to fit the curves. The methods of attack and the power-service units involved will be found to apply not only to the hotel field, but to all great buildings and—fundamentally—to all industry.*

THE engineer thinks of heat balance, kilowatts, steam flows, gallons of water per minute, passenger miles of elevators. His public—everybody else for short—knows nothing of these things, and cares less, but demands service ever better and better to keep pace with growing prosperity. Swift-moving elevators must handle with dispatch the morning and evening surges in office buildings. The theater must be cool on hot summer days. Warm comfort must greet winter guests as they enter the lobby of the great hotel. In the restaurant, food—piping hot and icy cold—must obey the whims of appetite. Light, ventilation and laundry must render service, complete and unobtrusive.

All of these things are nothing more than the elements of the engineer's heat balance, expressed in human values instead of British thermal units. These are therefore the beginning and the end of the power-service problem in every great building, whether it be a theater, hospital, office building, college or hotel.

No more perfect symbol of these human services may be found than a great modern hotel and, therefore, no more perfect symbol of the power services that produce them: Steam, electricity, vertical transportation, hot and cold water, refrigeration, heating and ventilation and air conditioning, communication, and so on. For that reason the New Yorker Hotel, now nearing completion, has been chosen to localize and symbolize the power services which are the real theme of this number of *Power*.

The present article, and the others in this number, will discuss in detail the complex mechanical organization of the New Yorker not for its own sake simply—interesting as that would be—nor merely as a fine example of modern hotel engineering. This number of *Power* will fall short of the aims of the editors if it fails to show, by implication at least, the approach to power-service problems in any great building, and in fact, in all industry

as well. For the steel mill, textile plant and chemical industry have these same problems—equally exacting demands for heat, cold, pressure and electrical energy. They too demand service, prompt and complete, although without the veneer of art and domesticity that must conceal the mechanism of personal-service institutions.

With this preamble, let us look again at the New Yorker as a great engineering mechanism whereby the raw sources—air, fuel and water—are transformed into human services. "Food, Comfort, Convenience and Cleanliness" are clearly the prime factors in the problem. *Food* means steam for cooking, hot water for dish washing, refrigeration for preservation and preparation. *Comfort* means heat in winter, air conditioning in summer and ventilation all the year round. *Convenience* means elevator service, light, systems of communication operated by air and electricity. *Cleanliness* means baths, hot and cold, steam and hot water for laundry, vacuum for cleaning.

A relation chart of the power services for a plant generating all of its own power by steam and Diesel engines is shown on page 828. To clarify the picture, minor details has been omitted and power services have been divided into two classes—"intermediate" and "final." The more important applications of the "final" services are indicated at the right.

This chart clearly shows the necessity of considering the power services as a unit in design and operation. Take, for example, the single item of air conditioning in the "final service" column. The production of conditioned air requires pumped water, refrigeration, blown air (fans) and steam. Overlooking the indicated alternate steam drives of pumps, compressors, etc., water is pumped by electricity, which, in turn, requires fuel oil (Diesel engines) or steam, preceded by coal, water and air, for its production. Refrigeration demands pumped water and electricity directly, the latter being the ultimate product of fuel oil or coal, water and air as before. Blown air is a composite of air and electrical power, the latter again requiring fuel oil, or coal, water and air. Finally, the steam used directly in air conditioning is produced from coal, water and air.

This sounds complex enough, yet it overlooks many important details. For example, steam production for the engine generating electricity in turn requires electricity, water and air for feed pumping, fuel preparation, firing and forced draft.

The chart shows how completely the various power services are interwoven and explains why all of them must of necessity be designed and operated as a single complex unit.

It must be obvious that the proper design and layout of such an assemblage of power services are, by their very nature, more involved than those of a central station, even of the large modern power house employing many refinements and complications not commercially feasible in a smaller plant. Measuring variations in percentages of total first cost, or of total operating cost, it is certainly true that the modern building's "power plant" (using the term properly to include the entire power-service layout from the lowest subcellar to the flagpole) is far more affected by the skill of designer and operator than is the case with the central station. Many more variables must be studied and reconciled.

The principal variables in *conditions* to be met in the design of a central station are in kinds and prices of available fuel, load factor, quantity and temperature of circulating water and the cost of developing various sites, together with their location in respect to the load centers.

The building plant, on the other hand, supplies not one commodity, electricity, but a half dozen or more primary services, with many more resultant services. Each of these services may be furnished in several ways. For example, electricity may be purchased or generated. Part may be bought and part manufactured by oil or steam engines. The steam-generated power may be entirely or in part the byproduct of process and heating steam.

Instead of considering merely load factors and available fuel and sites, a comparative study must be made of steam and electric load curves with particular reference to time, duration and amount of low-pressure steam loads that cannot be generated as a byproduct. Various combinations of steam and Diesel units must be juggled with intricate purchased-power rate schedules. The additional possibility of purchasing all or part of the steam must be considered, as well as the possibility of generating power from purchased steam. Cost of stand-by units must be compared with the expense of breakdown connections, and various plans for salvaging some of the costs of stand-by connections must be studied.

Finally, the various heating, lighting, laundry, kitchen, air conditioning, elevator and other loads themselves must be studied to see what can be done to reduce them or have their peaks occur at more favorable times. Anyone who has played with the arithmetic of permutations and combinations can see at a glance that the possibilities are numberless. Real engineering intuition is required to

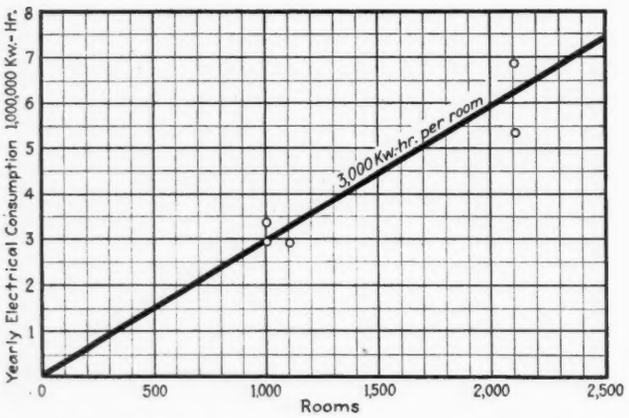


Fig. 1—Relation of number of rooms to total yearly electrical consumption for all purposes

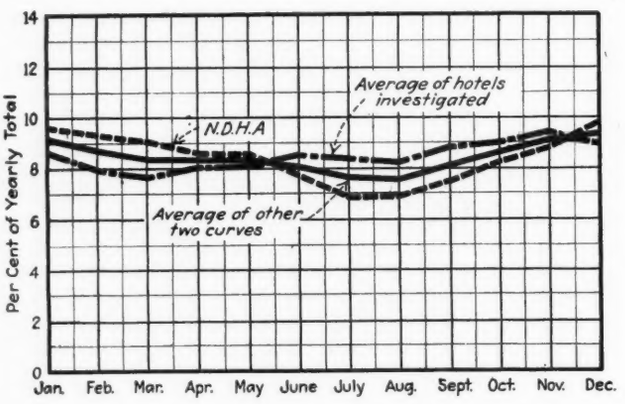


Fig. 2—Monthly electrical consumption expressed as a percentage of yearly total

cull out the more unsuitable combinations at the very start and then organize the investigation in a way that will get an answer nearly perfect with a reasonable amount of study. To arrive at the "one best solution" in such problems is a Utopian ideal, but the experienced and resourceful engineer will closely approach it if he goes at the problem properly.

While it is impossible, in the space here available, to make such a complete analysis, the general method of approaching the problem can be illustrated. The first thing to study in any case is the expected loads. In this it is absolutely necessary to lean heavily on experience with similar buildings. For practical purposes, also, it is generally better to study total steam and electric load curves rather than pile up errors by adding the curves for individual services. Only experience can show, for example, about what portion of the combined connected electric loads for lighting, elevators, pumping, ventilation and other services will fall on the lines at 8 p.m. of an average July day.

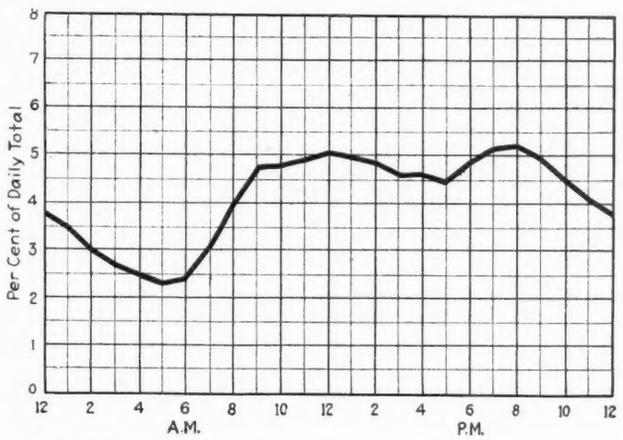


Fig. 3—Hourly electrical consumptions expressed as percentage of daily total, summer months

To make such a study for a hotel some unit figures are available, but they are far from satisfactory. In the preparation of this article I found it advisable to interview the chief engineers of several large hotels in New York to obtain data for steam and electric load curves.

Perhaps the best method yet devised for predicting hotel load curves is that contained in the 1923 proceedings of the National District Heating Association in a paper by the Heating Research Committee, consisting of F. R. Heath; W. J. Baldwin, Jr.; G. W. Martin; and H. T. Luscomb, chairman. The authors have there made public an ingenious method of apportioning the yearly demands for steam and electricity by months and by hours for large modern hotels. Some actual data, based on large hotels in New York and other large cities are also given in the 1923 N.D.H.A. proceedings. I thought it best, however, to use unit figures based on my own investigations, combining them with the N.D.H.A. figures where practicable.

Certain of the fundamental curves here shown will to some extent be usable in estimating load curves for other hotels, but their application should not be stretched too far. For instance, these curves should not be applied to small hotels or hotels located in sections of radically different climates. The *method* illustrated is, on the other hand, most general and worthy of much more extensive application than it has yet received. Such use will be accelerated as more hotels and public buildings keep, and make public, adequate power-service records.

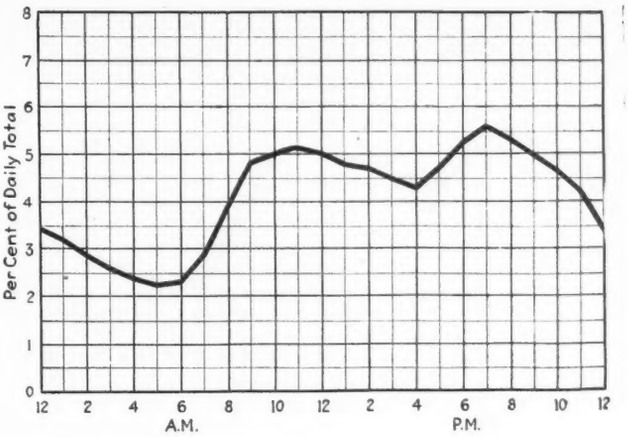


Fig. 4—Hourly electrical consumptions expressed as percentage of daily total, winter months

The matter of cost will not be gone into here, as that receives extensive treatment in the article "Diesel Yoked to Steam," on page 833.

In brief, the N.D.H.A. method is as follows: First, the yearly consumption of electricity, steam, etc., is plotted against the number of guest rooms or the cubical content of buildings. From these curves the yearly consumptions for the given building are estimated.

Next, average yearly curves are prepared (from a study of similiar buildings) showing the percentage of total yearly load that occurs in each month. From these percentages the consumption for any month may be estimated. This figure, divided by 31 (days in a month) gives the daily consumption for the given month.

The next step is to plot average curves (for winter and summer) showing what percentage of the total daily load occurs in each hour of the 24. From these and the daily totals the daily load curves can be plotted.

In one sense, load curves obtained in this manner are a guess, but a scientific guess of great value to the designers, who must decide somehow what demands the plant must provide for and what type of installation is likely to give the best commercial economy. This method will now be used to predict approximately the load curves of the New Yorker.

Fig. 1, based on several New York hotels, shows a close straight-line relation between the yearly total kilowatt-hour consumption and the number of guest rooms, so this basis will be used for computing electrical loads. It

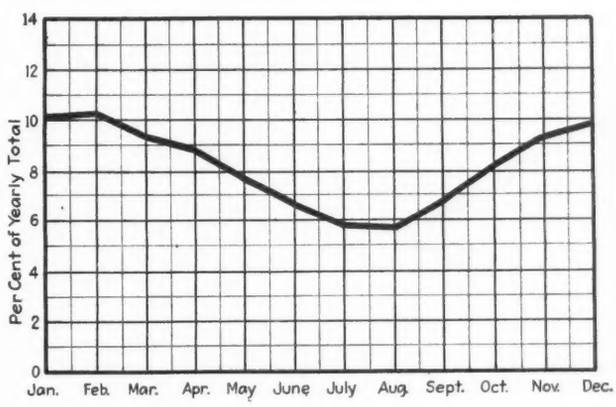


Fig. 5—Monthly consumptions of low-pressure steam as a percentage of yearly total

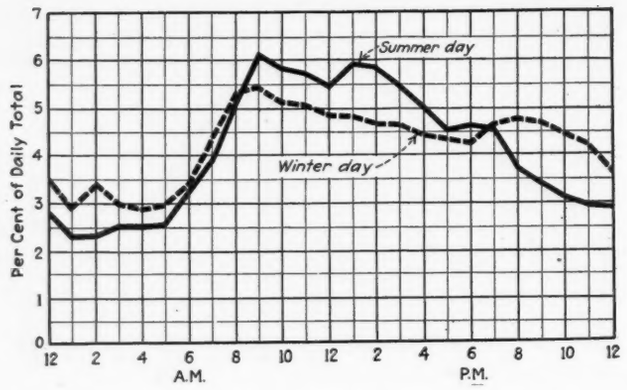


Fig. 6—Hourly consumption of low-pressure steam expressed as a percentage of daily total

will be shown later that cubical content is a better basis for predicting steam loads.

Multiplying 3,000 kw.-hr. per room (from Fig. 1) by 2,500 (the number of guest rooms in the New Yorker), we get a yearly estimated consumption of 7,500,000 kw.-hr. While this figure is higher than those assumed by the Edison company and the engine builder in the article already mentioned, it will be retained for the purposes of this study.

The next step will be to investigate extreme summer and winter conditions, say for July and January. From Fig. 2 it will be seen that 7.6 per cent of the yearly load, or 570,000 kw.-hr., will fall in July. This gives 18,400 kw.-hr. per day. To this is added an estimated daily load of 2,400 kw.-hr. for additional air-conditioning equipment not found in the hotels studied, giving a final daily load of 20,800 kilowatt-hours.

Applying this total to the hourly summer percentages of Fig. 3, we obtain the hourly curve of actual kilowatts, shown as the solid line in Fig. 7. Assuming power to be generated by uniflow steam engines with a constant steam rate of 28 lb. per kilowatt-hour, we obtain the available exhaust curve, shown dotted.

Similar curves for a January day (Fig. 8) are worked out in the same way, using 9.2 per cent, from Fig. 2, and applying the percentages in Fig. 4.

A similar procedure is followed in predicting hourly demands for high- and low-pressure steam. Here, however, it is found that the yearly demand bears little relation to the number of guest rooms, being much more nearly proportional to the cubical contents of the building. Nevertheless rooms are a fair measure of such parts of the load (kitchen, laundry, etc.) as depend primarily on the number of guests served.

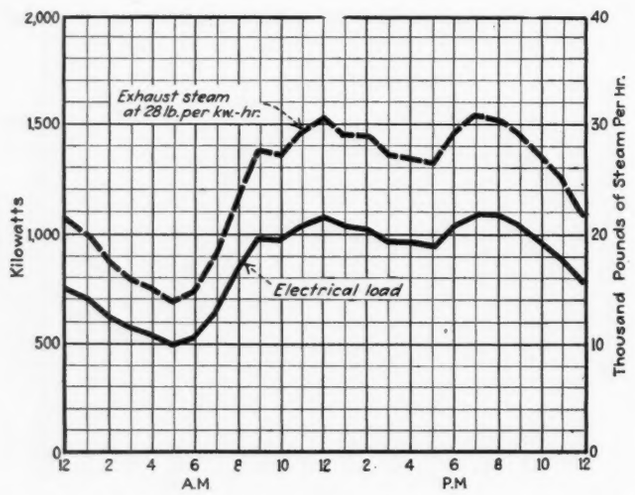


Fig. 7—Estimated July-day electrical load and available exhaust for the New Yorker

The hotels studied showed an average of 11.6 lb. of low-pressure steam consumed per year per cubic foot, and 122,000 lb. per room. With 12,400,000 cu.ft., the New Yorker would then show 144,000,000 lb. on the contents basis and 305,000,000 lb. on the room basis.

The discrepancy is large, and any attempt to resolve it must necessarily be open to criticism. However, it seems reasonable to base the estimate on a weighted average giving double weight to the cubical contents figure. The result of this computation is a yearly low-pressure steam consumption of 198,000,000 lb. Again, as was the case with the electrical consumption, this is substantially higher than the estimates used in the other article to which reference has been made. Possibly it is actually somewhat high; final proof of that point must await experience with the hotel for at least a year.

Applying to this figure the percentages shown in Figs. 5 and 6, we obtain the demand curves shown solid in Figs. 9 and 10. The upper dotted curves of available exhaust in these figures are repeated from Figs. 7 and 8.

The upper dotted curve in Fig. 9 would indicate a continuous waste of exhaust steam in summer. Much of this waste can be avoided by operating the Diesel unit that has been installed along with uniflow engines. Operation of the Diesel at a load of 350 kw. would lower the exhaust steam line about 8,400 lb. of steam per hour, as

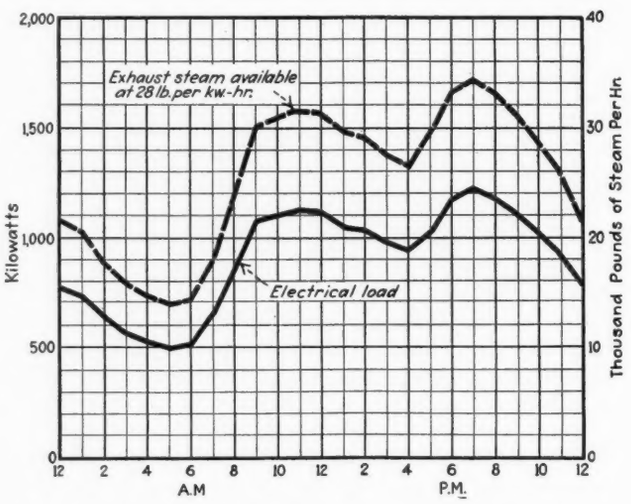


Fig. 8—Estimated January-day electrical load and available exhaust for the New Yorker

shown in Fig. 9, leaving only a small waste of exhaust steam from 5 p.m. to 2 a.m.

In view of the small margin indicated, it seems possible that this waste may be avoided altogether by suitable control of certain loads in the actual operation of the hotel. Strange to say, the winter curves for steam engines only (Fig. 10) also show a slight waste of exhaust steam. This, however, could easily be prevented by operation of the Diesel at certain periods.

Certain assumptions made in the foregoing computations call for further explanation. For example, it may not be clear why 2,400 kw.-hr. has been added to the summer daily total to take care of air conditioning.

The operations required for air conditioning are a combination of washing, refrigeration, reheating and ventilation. The ventilating portion of this load (and, in some cases, the air washing) is provided in hotels on which the curves have been based, so that only the refrigeration and water circulating need be added. Installed equipment for these purposes has a connected motor load of 250 kw. A daily correction of 2,400 kw.-hr. corresponds to a daily demand factor, on these motors, of 40 per cent, which would appear to be within reason.

Again, the reader may question the propriety of applying a flat steam rate of 28 lb. per kilowatt-hour to all loads. However, the error introduced by this assumption is small. With several uniflow engines installed, and

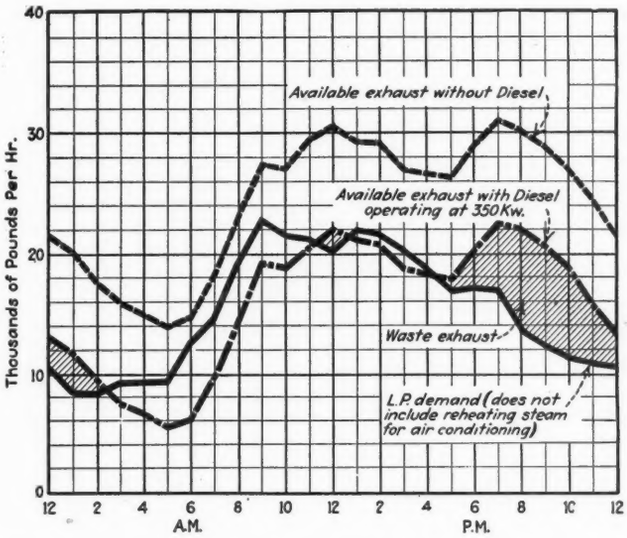

Available exhaust without Diesel
Available exhaust with Diesel operating at 350 Kw.
Waste exhaust
L.P. demand (does not include reheating steam for air conditioning)
Thousands of Pounds Per Hr.
A.M.
P.M.

Fig. 9—Comparison of low-pressure steam and available exhaust in July for the New Yorker

with careful scheduling of their operation, it is possible to maintain the group steam rate between 27 and 29 lb. over a wide range of plant load. This statement can be checked by a study of the engine guarantees tabulated on page 835.

With the three 600-kw. units and the one 400-kw. unit actually installed, the total load can be varied from 200 kw. to 2,200 kw. without exceeding a 29-lb. over-all steam rate.

There is, obviously, an opportunity for substantial error in the shaded areas indicating excess exhaust steam, since these areas represent the difference between two nearly equal estimated curves.

The installed capacity of 2,575 kw. may seem excessive when viewed in the light of the load curves, even allowing for exceptional days and for momentary peaks considerably higher than the hourly averages. This is explained by the fact that provision has been made, both in boiler and generator capacity, for service to other buildings that may soon be erected in the same block. It is even possible that the load may grow enough in two or three years to justify the installation of an additional Diesel engine.

A word of explanation is needed regarding the deduction from exhaust steam when the Diesel is running. Heat salvaged from the jacket water and exhaust of the Diesel by a special service warm heater is equivalent to about 4 lb. of steam per kilowatt-hour. Subtracting this

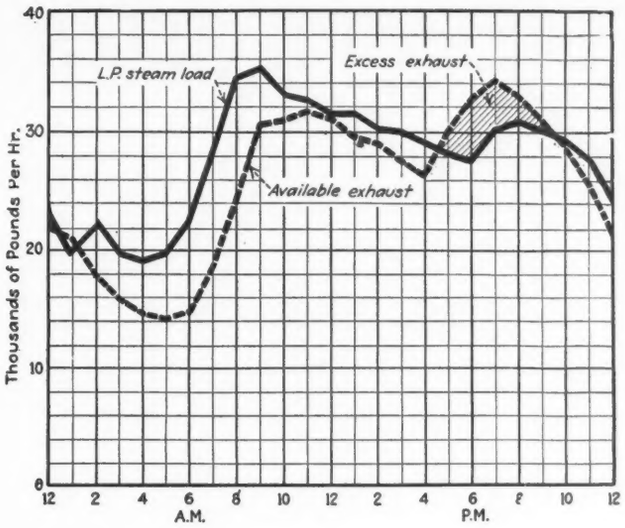


Fig. 10—Comparison of low-pressure steam and available exhaust in January

from the 28 lb. steam engine rate and multiplying the difference by 350 gives the 8,400 lb. steam per hour deducted for operation of the Diesel at 350 kw. In practice, the Diesel would be run only when necessary to avoid excess exhaust steam, or as a breakdown spare, since its fuel costs more per heat unit than that used in the boilers.

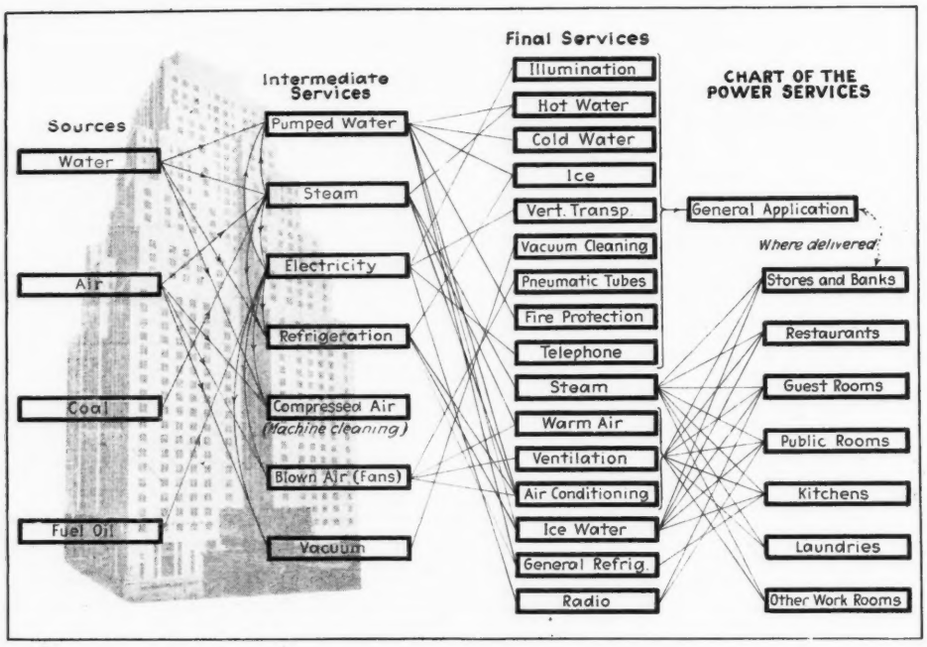
The study here started could be continued by considering the cost of producing power in various ways and making comparisons with purchased current. In view, however, of the fact that the article on page 830 summarizes preliminary cost analyses made by the New York Edison Company and by the builder installing the steam engines, it is thought best to leave the present analysis at this point. Incidentally, these differ considerably from each other and from the present partial analysis. No two estimates in such matters can agree exactly when there is such room for differences of opinion as to expected loads.

◆

IN CONCLUSION

This article demonstrates a method and reveals a need—the predicted load curves for the New Yorker are of secondary interest. The *method* of predicting load curves of specific buildings from basic curves of unit consumption and percentage distribution is of great practical value now, but its value will be far greater when more plants keep adequate records and make them available for the common good of designers, operators and owners.

CHARTING POWER



VIA THE NEW YORKER

THE POWER SERVICES *of the New Yorker are covered at length in the pages that follow. As a broad sketch covering the main points only, and those very briefly, the present article will serve as the introductory remarks of a guide about to conduct the reader through the plant. And the "plant," by the way, is not confined to the engine room and boiler room. It extends from the fourth cellar to the penthouse, nearly 500 ft. above the street. In this respect it is typical of all building plants.*

THE NEW YORKER, which will open for business shortly after this issue goes to press, stands in the heart of Manhattan, extending from 34th to 35th St. on the south side of Eighth Ave. With 2,500 guest rooms, and towering 43 stories above the street level, it is New York's largest and newest hotel. The total building space amounts to 12,400,000 cu.ft., of which approximately 2,000,000 cu.ft. is below ground.

In addition to the usual hotel facilities, the New Yorker provides space on the ground floor for banks and stores. Boilers and generators have ample capacity to take care of other buildings to be erected later on the same block.

All electricity used is produced in the hotel by four uniflow-engine-driven generators and one Diesel. There are three 600-kw. uniflows and one 400-kw. The Diesel, installed as a breakdown unit and to improve the summer heat balance, has a capacity of 375 kw., giving a total generating capacity of 2,575 kilowatts.

Four 6,500-sq.ft. boilers, fired by unit pulverizers, generate steam at 175 lb. pressure. To permit operation on pulverized coal without creating a dust nuisance a collector designed to remove 70 per cent of the fly ash has been installed on the roof. Draft is furnished by a stack 520 ft. high, with a diameter of 7 ft. 10 in. at the top.

Superheated steam is used only in the engine-generator sets and in a 200-hp. engine driving a CO_2 refrigerating machine. High-pressure saturated steam is used to operate the fire pump, spare water service pump and spare boiler-feed pump. Steam at 100 lb. pressure is delivered to the laundries and valet service. The 100-lb. pressure is reduced to 40 lb. for special applications.

There are two 40-lb. steam lines. One delivers steam to the exhaust header through a reducing valve which lowers the pressure to 3 lb., while the other supplies emergency steam to the kitchen and to the heating stacks of the air-conditioning unit, where the pressure is reduced to 5 lb. Two feed-water heaters receive condensate from the heating system returns and the hot-water heaters.

Five air washers, 166 tons of refrigeration and 34 fans having a total capacity of over 900,000 cu.ft. per minute, cool and ventilate the New Yorker Hotel. The air-conditioned spaces comprise the main dining room, banquet hall, grill room, barber shops, main dining room and eight private dining rooms.

Heating is divided into three main sections: That which supplies the guest rooms from the 24th floor to the roof; that supplying the guest rooms from the 24th floor down to the 5th floor, inclusive; and that supplying the public rooms from the 1st to the 4th floors, and also the work spaces in the four sub-basements. A total direct radiation surface of 103,160 sq.ft. has been provided in 4,902 radiators. Heating of all of the cellar space is by indirect method.

Twenty-two elevators and five dumbwaiters are in-

cluded in the vertical transportation system. Eighteen of the elevators (twelve passenger and six service) operate at 700-ft. per minute. The twelve-passenger elevators are of the latest automatic signal control type.

In all about 3,700 hp. of motor capacity is required to drive service equipment in the New Yorker. Motor sizes range up to 200 hp. This total capacity includes 400 hp. on ventilating fans, 400 hp. on refrigerating equipment and 900 hp. on pump drives.

As is the case with many public institutions, the New Yorker has installed carbon-dioxide compressors. This avoids the unpleasantness that occurs when a pungent refrigerant is used. Two 120-ton compressors, one motor-driven and one steam-engine-driven, care for the refrigeration needs of the kitchen storage boxes, ice freezing tank and dumbwaiter. A small 15-ton motor-driven compressor handles the ice-cream making and sharp freezing requisites.

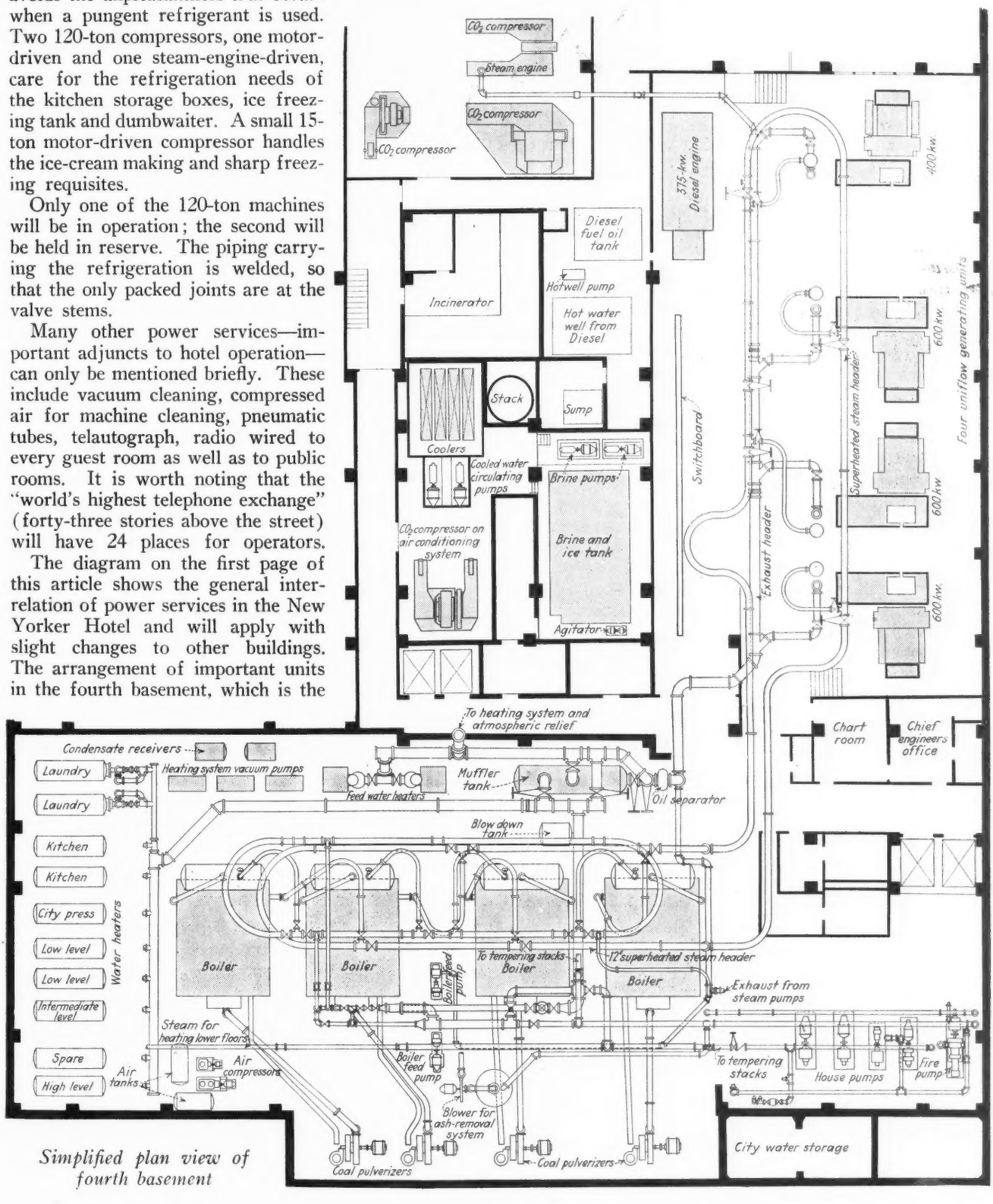
Only one of the 120-ton machines will be in operation; the second will be held in reserve. The piping carrying the refrigeration is welded, so that the only packed joints are at the valve stems.

Many other power services—important adjuncts to hotel operation—can only be mentioned briefly. These include vacuum cleaning, compressed air for machine cleaning, pneumatic tubes, telautograph, radio wired to every guest room as well as to public rooms. It is worth noting that the "world's highest telephone exchange" (forty-three stories above the street) will have 24 places for operators.

The diagram on the first page of this article shows the general interrelation of power services in the New Yorker Hotel and will apply with slight changes to other buildings. The arrangement of important units in the fourth basement, which is the principal power-service floor, is shown in the plan view on this page. Large piping only is shown in this view and many minor details have been omitted.

With this sketchy outline of the hotel and its equipment in mind the reader will be better able to understand the relation of the services as he reads subsequent articles.

Preceding the special-service articles, and directly following this, is a summary and comparison of two economic studies of purchased vs. generated power for the New Yorker. A general power-service equipment table for the entire hotel starts on page 865.



Simplified plan view of fourth basement

GENERATED OR PURCHASED POWER

FOR THE NEW YORKER

THERE IS NO GENERAL ANSWER *to the question, "generate or purchase?" True, the position of locally generated electricity is greatly improved if the nature of the building or industry insures a well-distributed demand for large amounts of low-pressure steam. Nevertheless, no final decision should be made until the total costs for each method of operation (including fixed charges) have been carefully compared.*

BY L. H. MORRISON
Associate Editor of Power

HOTELS require large amounts of hot water for guest, kitchen and laundry services, as well as steam for heating. As most of this heat can be obtained from the exhaust of generating units, the New Yorker Hotel installed its own power generating plant.

Before reaching a final conclusion as to the advisability of installing their own power plant, the owners and engineers made a careful study of the comparative economies obtainable through purchased power and through the operation of a hotel power plant. As the heating and hot-water requirements would be interlinked with the generating units, it was necessary to consider the total cost of power and heat, rather than the mere cost of generating power alone.

Two estimates were prepared; one was based on data supplied by equipment builders and one was offered by the public utility. The two estimates are reproduced in Table I, where Column 2 is that of the utility. In the totals shown at the bottom of each column, the coal for heating hot water, the boiler room labor and the overhead charges on the boiler equipment have not been included, as the comparison was desired only on the net cost of power generation. It will be seen that there is a marked difference in the assumed electrical loads, in the coal needed to supply the hot water, steam heat and laundry services and in the assumed water rates of the engines. This causes the totals of the two estimates to be widely divergent.

The heating data offered by the utility and reproduced in Column 2 of Table I were based on three hotels of 14, 12 and 7 million cu.ft. volume, in which for all heating and hot water the average pounds of steam per million cubic feet of space was 1,376,000. This for the New Yorker, with its 12,400,000 cu.ft. of space and on an assumed evaporation of 8.5 lb., gave 10,050 tons per year.

The steam-heating requirements were based on three hotels where the evaporation rate was said to be only 6.5. For the New Yorker, with 8.5 lb. evaporation and with the average of the three hotels as a basis, the heating would require 3,500 tons, as shown in Column 2.

For hot water, Column 2 estimate took as a basis two tons of coal per bathroom per year on a 6.5 lb. evaporation. This for the 2,506 rooms originally planned for the New Yorker, with an 8.5 lb. evaporation, called for 3,840 tons of coal. The kitchen and laundry item was arrived at by subtracting from the total tonnage of 10,050, established from the three hotels, the heat and hot-water requirements, resulting in 2,710 tons.

In Column 1 of Table I the estimate agreed upon by the engineers and machinery builders was 3,340 tons for steam heating and 4,308 tons for hot water. In the laundry it was assumed that 8,000 gal. of water would be used per hour for 16 hr. per day, 5,000 gal. per hour for 16 hr. for the kitchen, and 30 gal. per day per room, making a total of 283,180 gallons per day. With a temperature rise from 60 to 180 deg. F. and 970 B.t.u. recovery per pound of steam, 4,310 tons of coal would be needed per year. This includes a so-called "occupancy" factor of 85 per cent. It was also assumed that the laundry, bath and kitchen demand would be uniform over the year and would require coal at the rate of 359 tons per month. It should be understood that this total included the coal needed to generate the high-pressure steam required by the kitchen and laundry.

In establishing the total yearly electrical consumption the item in Column 1, Table I, was based on an estimated connected power load of 2,910 hp., a connected lighting load of 908 kw., which with the appropriate load factor gave an estimated yearly consumption of 6,766,200 kilowatt-hours.

In arriving at the tons of coal needed to supply the steam required by the generating units the two estimates

TABLE I—ESTIMATES OF ADDITIONAL YEARLY PLANT OPERATING COSTS IF GENERATING UNITS ARE INSTALLED

Item No.		Estimate No. 1 (By Engineers)	Estimate No. 2 (By Utility)
1	Heating coal, tons	3,340	3,500
2	Hot water for rooms	4,308	3,840
3	Hot water for kitchens and laundry	.....	2,710
4	Total service coal, tons	7,648	10,050
5	Coal cost	[1]$47,065.80	[2]$60,300
6	Electrical consumption, kw.-hr	6,766,200	5,125,000
7	Steam rate, lb. per kw.-hr.	28	46
8	Evaporation, lb. water per lb. coal	10.5	8.5
9	Power-coal, tons	9,024	13,900
10	Exhaust value (tons of coal)	6,322	7,170
11	Gross power-coal cost	$55,533.70	$83,400
12	Exhaust value	$38,905.59	$43,020
13	Net power-coal cost	$16,628.10	$40,380
14	Water make-up	$1,044	$1,640
15	Labor, excess over that needed if power is purchased	$1,910	$25,400
16	Supplies and repairs, excess	$2,200	$12,000
17	Interest and depreciation on generating units	$23,100	$35,000
18	Insurance	$2,200	$2,000
19	Space value	$2,000	$2,000
20	Ash removal of net power-coal	$414.40	$1,033
21	Total cost, sum of items 13 to 20	$49,496.50	$119,453
22	Cost per kw.-hr., mills	7.3	23

[1]Based on coal at $6.154. [2]Based on coal at $6.

in Table I show marked differences. The engine builders, in the final contract, guaranteed that the steam rate per kilowatt-hour would not exceed 28 lb., and the contract includes a penalty for each $\frac{1}{10}$ lb. of steam needed per kilowatt-hour above the 28 lb. Based on records of other uniflow engines operating under similar conditions, there is every reason to believe that these engines will show a steam consumption well under the guarantee. To legalize this penalty a bonus clause was added, giving the builder $1 per 100 kw. capacity for each $\frac{1}{10}$ lb. the engines bettered the guaranteed rate of 28 lb.

The coal needed to generate 6,766,200 kw.-hr. under the conditions of Column 1 Table I, figured 9,024 tons. This assumed an evaporation rate of 10.5 lb. steam per pound of coal. The builder of the coal pulverizer guaranteed an over-all boiler efficiency of 79 per cent. On this basis, the 10.5 lb. is probably a trifle high. For everyday operation 10 lb. would appear to be nearer the real figure. The utility used a figure of 8.5 lb. This low value is quite usual in hand-fired plants, but it is reasonable to expect a better rate in a modern pulverized-coal boiler plant such as is installed in the New Yorker, where a steam pressure of 165 lb. is employed. In Column 1, Table I, the total power coal was calculated as 9,024 tons, while in Column 2 the tonnage was taken at 13,900.

In computing the value of the exhaust steam, and, consequently, the power coal to be credited back to the generating plant, it was necessary to establish the monthly power load, hot-water requirements and steam heating. For Column 1, Table II was prepared.

The total tons of coal needed for heating was segregated by percentage into monthly requirements as shown. The hot-water needs were assumed to be uniform over the year. The sum of these gave the total low-pressure steam in terms of tons of coal, using a 10.5 lb. evaporation rate.

It was assumed also that the power load would be uniform over the year, calling for 752 tons of coal per month. On account of the heat abstracted from the steam in the conversion into power, and that lost by radiation, only 85 per cent of the heat in the steam going to the engine was taken as available in the exhaust steam. Consequently this deduction was made from the monthly power-coal total, giving the value, in tons of coal, of the exhaust steam as shown in Col. 7, Table II. But as only a part is needed during the summer months, the final column in Table II shows the *net* exhaust value. This is the yearly total, then, of the coal used for power generation that can be used for heating and for hot-water services, and amounts to 6,322 tons. This leaves a net amount of coal directly chargeable to power generation of 9024 — 6322 = 2702 tons, which at $6.15 per ton appears as item 13 in Column 1, Table I.

The utility set up a somewhat similar schedule as shown in Table III.

This indicated, so the utility's report stated, that a total of 16,780 tons of coal would be needed, and 7,170 tons of the power-coal was deductible from the cost of generating power. These values were used in Table I, Column 2.

Turning to the labor item, the consulting engineer set down $1,910 as the excess labor needed if generating units were installed. On the other hand, the utility set down $25,400 as that needed above the labor cost that would exist if power was purchased. This will be discussed later, when comparison will be made between the purchased and the generated power estimates.

TABLE II—COAL CONSUMPTION BY MONTHS
(Used in Estimate No. 1.)

1 Month	3 Heating, Tons	4 Hot Water	5 Total L.-P. Steam	6 Power Coal	7 Available Exhaust Value	8 Value Exhaust
January	668	359	1,027	752	639	639
February	668	359	1,027	752	639	639
March	501	359	860	752	639	639
April	334	359	693	752	639	639
May	167	359	526	752	639	526
June	0	359	359	752	639	359
July	0	359	359	752	639	359
August	0	359	359	752	639	359
September	0	359	359	752	639	359
October	167	359	526	752	639	526
November	334	359	693	752	639	639
December	501	359	860	752	639	639
Total tons	3,340	4,308	7,648	9,024	7,668	6,322

Column 2, covering percentages, has been omitted.

Supplies and repairs for the generating units was listed at $2,200, in Column 1, while the utility set down $12,000, in Column 2.

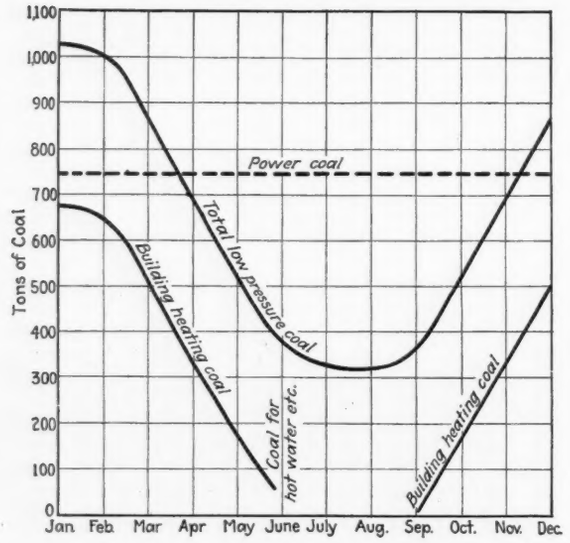
Insurance was taken at practically the same amount in both estimates, as was also the case with the space value, which is equivalent to 35c. per sq.ft. of floor space.

Ash removal for the coal that was charged directly to the power-generating costs was set at $414 and $1,033, respectively, based on coal with 12 per cent ash, 80 per cent of which it was assumed must be removed, at 8c. per 100 pounds.

Adding the items in each column, after deducting the value of the exhaust steam gives a total for Column 1 of $49,497.10, and $119,453 for Column 2.

In Table IV are estimates made by the utility on the comparative costs of generated and purchased power.

In computing the electrical load for the hotel if current were generated the utility assumed a value of 4,875,000 kw.-hr., to which was added a coal-pulverizer load of 170,000 kw.-hr., making a total of 5,045,000 kw.-hr., as shown in Column 1, Table IV. As the engines, due to radiation losses, would entail more ventilation than otherwise, and on the basis that a more careful use would be made of purchased power, a deduction of 200,000 kw.-hr. was made for the total, giving a net yearly consumption of



Coal requirements for a year used in Estimate 1 of Table I

4,845,000 kw.-hr. if electricity was purchased. The cost of the energy was calculated as 3,000,000 kw.-hr. at 2.32c. and 1,845,000 kw.-hr. at 2c., to which was added the coal clause charge of .28c. This, on the 4,845,000 kw.-hr., was $13,566. These items brought the electrical energy cost to $120,090.

The coal shown in the first column of Table IV is that used in the Column 2 estimate of Table I, and is the public utility's calculation. As has been stated, it is that estimated by the utility as needed to supply the heating, hot water, and steam to the kitchen and laundry. The labor item in the first column is that assumed by

TABLE III—UTILITY'S FUEL CONSUMPTION ANALYSIS

High Pressure Steam:	Winter	Summer	Total
Power generation, tons of coal	8,750	5,150	13,900
Laundry and kitchen, tons of coal	1,580	1,130	2,710
Supplementary steam, tons of coal	170	0	170
Total high-pressure steam coal, tons	10,500	6,280	16,780
Low Pressure Services:			
Exhaust available, 85 per cent, tons of coal	7,440	4,380	11,820
Exhaust used, not more than 75 per cent of available exhaust, tons of coal	5,570	1,600	7,170
Exhaust wasted, tons of coal	1,870	2,780	4,650
Building heating, tons of coal	3,500	....	3,500
Hot water, tons of coal	2,240	1,600	3,850
Total	5,740	1,600	7,340

the utility to be needed by the plant if generating units were to be installed, and is the payroll of: one chief engineer, one assistant chief, six assistant engineers and five boiler attendants; four oilers and four handymen. The item in the second column covers the pay of: one chief engineer, four assistant engineers and four boiler room attendants.

The chief engineer, who will have charge of the New Yorker's equipment, has stated that the actual force will consist of: chief engineer; one assistant chief; three watch engineers; three boiler engineers, three firemen; six oilers and two clean-up men. He has stated, also, that if the generating time were not included, his force could be reduced by three watch engineers and three oilers. The payroll will approximate $49,000, which is close to the estimate, and the absence of the engine room would have permitted a reduction of $12,700. It will be noted that this does not agree with either of the estimates used in Table I.

The items shown in Column 1, Table IV, are assumed to cover the cost if power is generated, and include not only the coal, labor, etc., needed for the generating units, but also all the coal needed for the hotel, all the labor and the entire overhead on boilers and engines.

The total cost was calculated as explained in Table I.

As the boiler capacity is determined by the heating load, for which only $4,000 is charged, in the second column, to cover repairs, apparently the item in the first estimate in Table I is made up of $8,000 for the generating units and $4,000 for the boilers, pumps and other steam-consuming equipment.

Interest and depreciation in Column 1, Table IV, are made up of 6 per cent interest and an 8 per cent depreciation on 2,000 kw. of generating units estimated at $125

TABLE IV—COMPARISON OF PURCHASED AND GENERATED POWER (including boiler room charges and coal for all services) AS OFFERED BY THE UTILITY

	Column 1 Generated Power	Column 2 Purchased Power
Power load, kw.-hr.	5,045,000	4,845,000
Coal	$100,680	$60,300
Ash removal	2,576	1,548
Water	1,640	.....
Labor	48,080	22,680
Supplies and repairs	12,000	4,000
Space value	2,000	.....
Interest and depreciation	46,760	8,820
Compensation insurance	960	450
Breakdown insurance	2,000	.....
Excavation cost	360	.....
Electrical energy cost	.....	120,090
Total	$217,056	$217,888

per kw. capacity, totaling $250,000. The same percentage was used for the 12,000 sq.ft. of boilers at $7 per square foot, including pulverizers, extra stack and flues.

The estimate on the cost of the generating units is about $40,000 above the final contract figure. Consequently, even if a charge of 14 per cent be agreed upon, the item in Column 1 should be reduced by approximately $5,600.

If the estimate in Table I be made to include the entire coal, labor and overhead charges corrected to meet the conditions, and the data in Table IV covering the cost of purchased energy be altered to cover 6,766,200 kw.-hr., the values given in Table V will be obtained.

On the basis of this comparison, it would appear power can be generated at a saving of $101,743,49 per year.

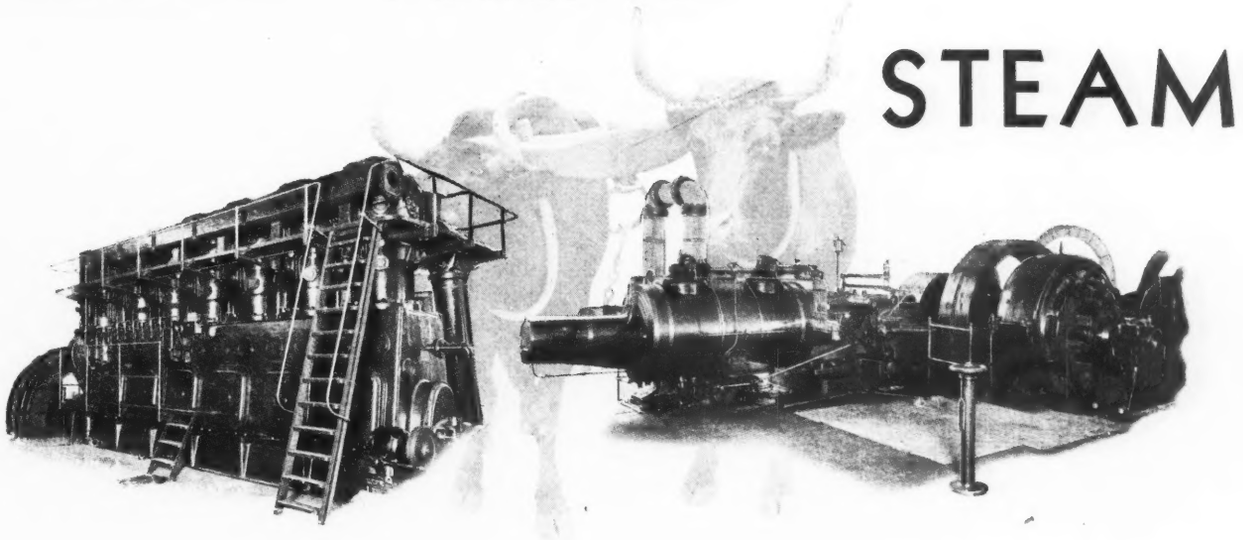
The study, as has been already stated, led to the installation of one 400-kw. and three 600-kw. uniflow engines direct-connected to direct-current generators, and a 375-kw. Diesel for breakdown and heat-balance purposes.

TABLE V—COMPARISON OF TOTAL PLANT COSTS WITH GENERATED AND PURCHASED POWER

(Based on 6,766,200 kw.-hr., 10 lb. evaporation and corrected for labor, etc.)

	Estimate A Power Generated	Estimate B Power Purchased
1—Heating coal, tons	3,507	3,507
2—Hot water, etc., tons	4,523	4,523
3—Total service coal, tons	8,030	8,030
4—Electrical consumption, kw.-hr.	6,766,200	6,766,200
5—Steam rate, lb. per kw.-hr	28	.....
6—Evaporation rate	10	10
7—Power-coal, tons	9,511	.....
8—Gross power-coal cost	$58,530.69	.....
9—Exhaust value, tons of coal	6,644	.....
10—Exhaust value	$40,887.18	.....
11—Net total coal cost	$67,060.13	$49,416.62
12—Water make-up	1,044.00	.....
13—Labor	49,000.00	35,300.00
14—Supplies and repairs	6,200.00	4,000.00
15—Interest and depreciation	31,920.00	8,820.00
16—Insurance	2,000.00	.....
17—Space value	2,000.00	.....
18—Ash removal	1,670.00	1,232.00
19—Electric current	.....	163,869.00
Total items 11 to 19	$160,894.13	$262,637.62

DIESEL YOKED TO STEAM



To Obtain Maximum Saving in operation it was necessary, after decision was made to install a power plant in the New Yorker, to determine upon the sizes and types of engine equipments to be installed. The plant selected consists primarily of steam engines. A Diesel engine has been added to give additional assurance against breakdown and, at the same time, improve the summer heat balance by cutting down the supply of exhaust steam.

OF THE five power units, three are 29x36-in. uniflow engines direct connected to 600-kw. 3-wire, direct current generators, the fourth unit is a 25x32-in. uniflow horizontal engine, direct connected to a 400-kw., 3-wire, direct-current generator, and the fifth unit consists of a 535-hp. Diesel engine direct connected to a 375-kw. generator unit. In addition there is a horizontal variable-speed 200-hp. uniflow engine direct connected to one of the CO_2 compressors in the refrigerating department of the hotel.

The total capacity of the steam-power units is over twice the hotel load, but the intention is to supply power and heat to other buildings to be erected on the same block. Consequently the hotel is by no means unduly overpowered.

Although the hotel owners are quite confident that there will never be a shutdown of the steam-generating units due to engine trouble, there is a remote possibility that the stack might need relining or a breakdown in the boiler room might occur. As a hotel must be prepared to offer its power services to its guests at all hours, some form of breakdown service was deemed desirable. The choice lay between a public utility connection and a Diesel engine, and the latter was economically more advantageous. But while the Diesel was installed primarily for breakdown service, it will be used to better the heat balance.

During the winter months there are periods during which the exhaust from the steam engines will be greater than needed for the hotel services; during these times the Diesel will be run with a load such that the atmospheric relief valve on the steam engine fails to open. In the summer the heating and hot-water requirements fall far below that obtainable from the steam engines' exhaust steam, and so for five months the Diesel will be used to avoid the loss of exhaust steam to the atmosphere. From March to October, Fig. 1, page 832 shows that the exhaust steam for the engine not used for heating, etc., is equivalent to 2,115 tons of coal. This tonnage develops $\frac{2{,}115 \times 2{,}000 \times 10.5}{28} = 1{,}586{,}300$ kw.-hr.

On the assumption that the Diesel engine will develop 11 kw.-hr. per gallon of fuel, 144,210 gal. of fuel oil will be needed; this will cost $7,210.50 at 5c. a gallon. The 2,115 tons of coal saved by operating the Diesel at $6.154 a ton would cost $12,988.71. It would probably be necessary to run the Diesel almost continuously at full load for the five months to enable it to generate this amount of power. It is necessary to take into account the lubricating oil, which will be about 2 gal. per day, or about 450 gal. for the running period. This adds $270 to the Diesel's operating costs.

Repairs on the engine should not exceed $1 per rated horsepower for a six months' operation period per year, or a total of $535. But as this reduces the running time of the steam engine, whose repairs and supplies are estimated at $1 per rated horsepower per year, the Diesel then carries a net increase in repairs of but one-half of $535, or $267.50.

This, however, is not all the saving made possible by the presence of the Diesel, for the entire heat absorbed by the engine's jacket water and part of the heat in the exhaust gases are to be recovered through the installation of a waste-heat boiler. The water leaves the jacket and passes through the exhaust-heat boiler before it enters the hotel hot-water lines. By this recovery the Diesel shows a efficiency approaching that of a steam boiler.

All of the jacket heat is recoverable, namely 5,034 B.t.u. per kw.-hr., and also a part of the exhaust gases. Of the heat in the water vapor portion of the exhaust gases, only part of the superheat is recoverable; if 250 deg. F. be assumed the lowest heater outlet temperature, the superheat recoverable per pound of oil is $0.45\ (660 - 250) = 184$ B.t.u. The heat in the gases above 250 is also recoverable, or $(660 - 250) \times 25 \times 0.17 = 1{,}742$ B.t.u. per pound of fuel. The total exhaust recovery is, then, $(1{,}742 + 184) \times 0.66 = 1{,}271$ B.t.u. per kilowatt-hour developed. In the total output of 1,586,300 kw.-hr. and assuming a steam boiler efficiency of 79 per cent and 13,000 B.t.u. coal this Diesel heat recovery including the jacket water is then,

$$\frac{(1{,}271 + 5{,}034) \times 1{,}586{,}300}{2{,}000 \times 13{,}000 \times 0.79} = 484 \text{ tons of coal.}$$

The heater manufacturer guaranteed an exhaust heat recovery of 672,000 B.t.u. per hour with the engine fully loaded. At $6.154 per ton, the saving during the five summer months becomes $2,978.54. The debits and credits for the Diesel's summer operation are, then:

Debits		Credits	
Fuel oil	$7,201.50	Power coal saved	$12,988.71
Repairs	267.50	Waste heat	2,978.54
Lubricating oil	270.00		
Total	$7,739.00		$15,967.25
Savings, operating	$8,228.25		

If the overhead charges are placed against the breakdown service, the operation of the Diesel will permit its cost to be written off in a few years. Even if interest is charged to operation, the surplus will write off the cost in a reasonable time.

The Diesel installed in the New Yorker is a solid-injection vertical four-stroke-cycle engine with eight cylinders 14½-in. bore by 18-in. stroke. When operating at a speed of 277 r.p.m. the normal rating is 535 horsepower.

To insure absence of vibration a layer of cork was interposed between the engine foundation and the building fittings. This has eliminated the transmission of all vibration, but the engine, in fact, is remarkably well balanced.

Due to the paucity of space, the Diesel is located in rather close quarters, as will be seen from Fig. 2. Air from the engine room is drawn in through a filter using an oil film as the dirt collector and through a muffler before it reaches the suction manifold. The exhaust gases can pass either through the waste-heat boiler, in a pit alongside the engine, or through a bypass line and muffler to the stack. The air and exhaust mufflers are unusually efficient, and no noise is detected. The control is through a balanced clapper swing valve. After leaving the heater the cooled gases, at a temperature of about 250 deg. F., enter a steel exhaust line leading to the 520-ft. vertical stack. This is 10 in. in diameter up to the third floor and from there to the outlet at the roof is a 12-in. spiral galvanized pipe. As the lining of the boiler stack may need repairs, the engine exhaust stack passes up alongside the boiler stack and not inside. It was believed that the long stack would exert a substantial back pressure. In starting, the engine shows the effect of the long column of cold air, but after warming up gives no indication of a back pressure. Each cylinder exhaust connection is fitted with a pyrometer plug so the cylinders can be balanced as to load.

Water for the cylinder jackets is taken from the service lines by a motor-driven centrifugal pump, and after it has passed through the jackets and waste-heat boiler it flows into a steel tank, or sump, out of which it is pumped to the feed-water heater and hot-water heaters as needed.

The fuel oil is stored in a steel tank under the floor, from which it is lifted by a motor-driven rotary pump to a service tank somewhat above the engine level. The lubricating oil is taken from a sump in the engine frame by a gear pump driven from the crankshaft and stored

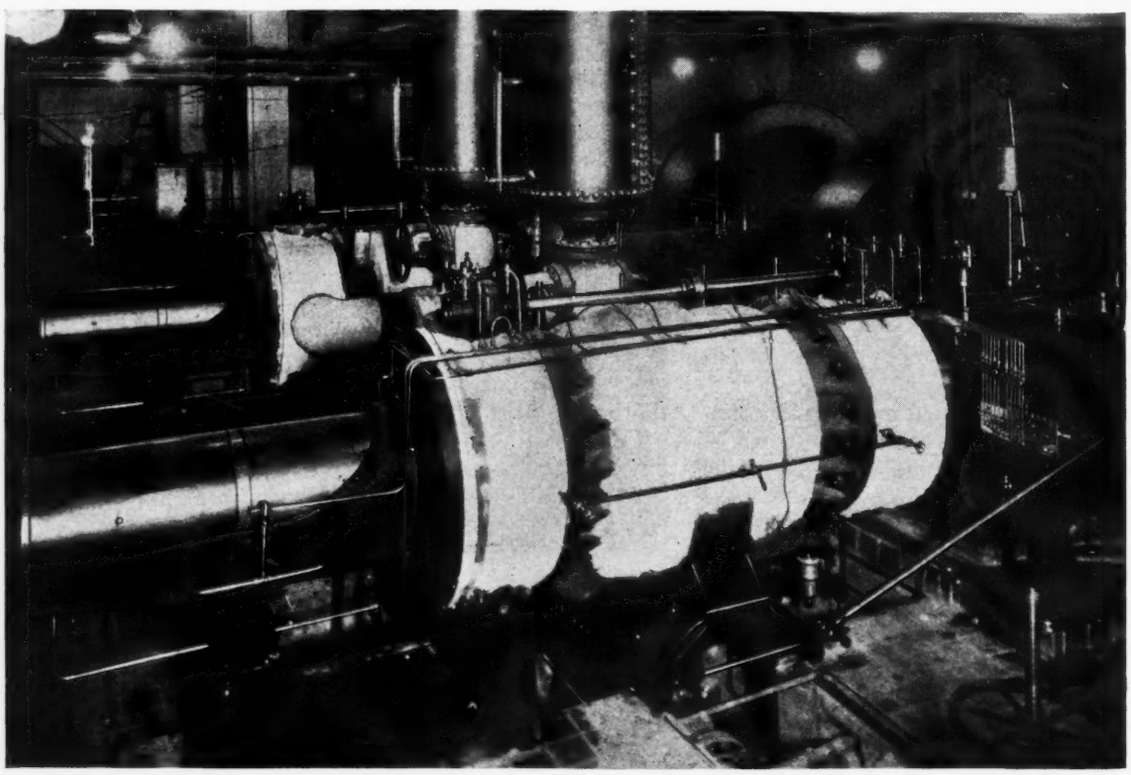


Fig. 1—View of engines before cylinders were lagged

in an overhead tank, which is airtight. Air is trapped into this tank and, as the oil pump delivers a greater supply than enters the engine feed lines, it is compressed there. A relief set at 60 lb. gage relieves any excess air.

About 4 gal. of oil per min. is bypassed from the overhead tank through a centrifuge. This is provided with an electric oil heater. After being centrifuged the oil is cooled in a water cooler. To prevent damage in case the lubricating oil pump should fail, an interlocked valve on the fuel oil line can stop the engine.

The engine uses the Price system of combustion, whereby the fuel is introduced by two nozzles, and burned in a combustion chamber in the cylinder head. Each cylinder has its own fuel-injection pump, which serves the two nozzles, the pump pressure being about 4,000 lb. per square inch when handling the 24 to 28 deg. Bé. oil that will be used in this engine.

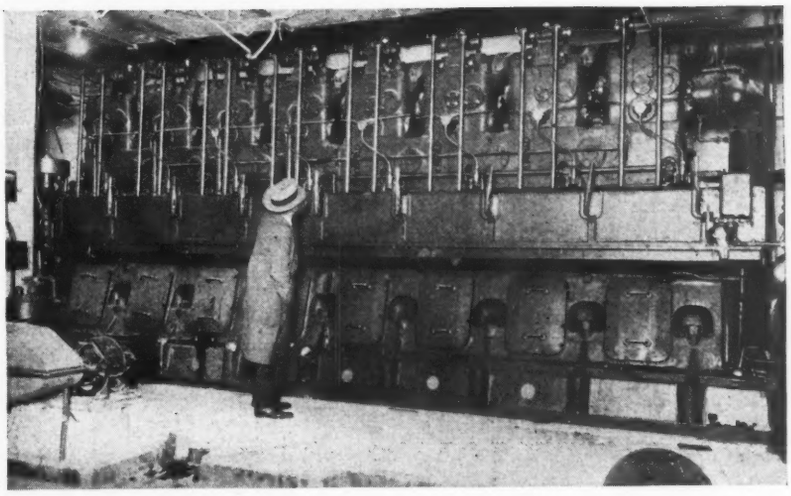


Fig. 2—The 535-hp. eight-cylinder Diesel

The steam units are designed to operate with a steam pressure at the throttle of 165 lb. gage, superheated 100 deg., and to exhaust at a maximum back pressure of 3 pounds.

It is contemplated that the 400-kw. unit will be operated to handle low-load requirements, and the 600-kw. units will be used for the heavy loads. It is estimated that two of these units will be ample to take care of the peak-load requirements. The two remaining generator units will always be in readiness for service in case of emergency. The average load is expected to be around 850 kilowatts.

The steam engines are of the uniflow poppet-valve design and are provided with auxiliary exhaust valves to permit non-condensing operation without excessive clearances. The pistons are full-floating, supported by tailrods.

The governor of each unit is in the flywheel and is of the flat-spring type. It will prevent the engine from racing or hunting and is amply powerful and sensitive to provide the required regulation.

Each engine has a complete independent automatic oiling system for the lubrication of the main bearings, rocker arm pins, eccentrics, bearings of the inlet valve gear, tailrod crosshead, outboard bearing and all reciprocating parts in the engine frame. The oil draining from the bearings is cooled and filtered for re-use.

The engine builder guaranteed the following steam rates:

STEAM RATE OF 600-KW. UNITS

	Load				
	One-quarter	One-half	Three-quarters	Full	One and one-quarter
Steam per kw.-hr., lb...	30.1	25.6	25.7	26.9	28.9
2-Lb. Gage Back Pressure					
Steam per kw.-hr., lb..	31.5	26.9	26.8	27.8	29.8

STEAM RATE OF 400-KW. UNIT

	Load				
	One-quarter	One-half	Three-quarters	Full	One and one-quarter
Zero Back Pressure					
Steam per kw.-hr., lb..	31	26.4	26.4	27.8	30
2-Lb. Gage Back Pressure					
Steam per kw.-hr., lb..	32.5	27.7	27.5	28.7	31

The contract specifies that at a time which the owner will name and within six months after these units have been erected and made ready for piping and electrical connections, the smaller generator unit and any one of the larger units must be tested to determine their steam economy, load and regulation.

The contractor provides without cost to the owner all suitable and necessary instruments, wiring, cables, water rheostats, equipment, accessories, and competent labor for conducting and determining the results of these tests, and must remove these articles from the plant immediately after the tests.

In the event that the average steam rate as determined by test is greater than the average of the guaranteed steam rates of the unit so tested, that unit and all other units of the same size will be considered as being of less value to the owner than was contemplated by the contract price. Therefore, for each $\frac{1}{10}$ lb. the average steam rate, proved by test as described, exceeds the average of the steam economy guarantees made a part of the contract, the contract price will be automatically reduced at a specified rate for each 100 kw. of the rated kilowatt full-load capacity of the unit so tested.

In case a deficiency in steam economy in one of the three 600-kw. units is proved by test, the rate of the deficiency in economy of the unit tested will be multiplied by three to determine the automatic reduction of the contract price as stated. All steam economy guarantees and tests are to be on the kilowatt-hour basis.

The cylinders are barrel-bored in such a manner that the bore will be straight when the engines are operating under the pressure and temperature conditions stated. The cylinder heads are made to receive the inlet valves. They are individual castings of the steam-jacket type and are of the same materials as the cylinders. Steam for engine operation passes through the cylinder heads before it enters the admission valves.

Steam is supplied from the boilers through a 12-in. loop steam header with long radius lines taken off at each engine. To prevent pressure surges and to eliminate all danger of water slugs, each engine has a large receiver separator above the throttle valve. In addition, each unit is provided with an emergency steam valve, which closes when the water in the receiver rises above a predetermined level. The separators, as well as the jacketed heads, are piped to traps located below the cylinders. The exhaust lines of the several engines enter a header which has an atmospheric relief line to the roof, with a diaphragm pressure-control valve.

PULVERIZED COAL

ENTERS THE HOTEL FIELD

By B. H. Pisow

Mechanical Engineer, Sugarman & Berger

THERE are many services in a hotel, in addition to that of power generation, that require steam. Among them are cooking, laundering, water heating and building heating. As indicated in a previous article of this issue, the average hourly maximum demand on a January day for steam by these various services, together with that necessary for power generation, is estimated at 42,000 lb. It is further estimated that the momentary peak during severe winter weather would not exceed 60,000 lb. per hour. Anticipating the erection of additional buildings behind the hotel that will be supplied with steam from the hotel boiler room, capacity for about double the present estimated steam load has been provided. Four 6,500-sq.ft. boilers have been installed, permitting the future load to be carried at 200 per cent rating on three boilers with one acting as a spare.

The boilers are of the water-tube cross-drum box-header type, with the drum set 28 ft. above the furnace floor, which is 10 ft. below the level of the fourth cellar and 65 ft. below the street. The drum elevation was determined by the necessity of keeping boiler, steam header and other auxiliary piping below the first cellar floor level and at the same time limiting the amount of additional rock excavation to a minimum.

The necessity of installing other mechanical equipment in the fourth cellar limited the dimensions of the boiler room to 62 ft. x 100 ft. This, together with the building column spacing, dictated a boiler width of 22 tubes, a height of 15 tubes and a tube length of 20 ft. Superheaters designed to deliver steam at 478 deg. are located between the first and second pass.

Pulverized-fuel firing and a desire to reduce brickwork maintenance indicated that an air-cooled setting would be advisable. The hollow wall construction is of the sectional suspended type, comprising 9 in. of firebrick, 9 in. of air space and 4¼ in. of insulating brick, making a total wall thickness of 22¼ in. The furnace bottom is also air cooled and consists of 6-in. hollow tile covered with 3 in. of insulating refractory cement and, in addition, two courses of firebrick laid flat.

Secondary air enters the setting at the front through the hollow bottom, passes up the back wall and around the sides to the front wall. Additional dampered openings, three in each side, six in the back and two in the front are provided to reduce the draft loss at high ratings.

The boilers operate on natural draft provided by a 520 ft. high 7 ft. 10 in. diameter stack. Building conditions made it necessary to locate the stack 82 ft. from the boiler room, necessitating the installation of a 5x9-ft. flue between the boilers and the stack. The flue is of concrete construction and runs below the fourth cellar floor. At maximum rating it is estimated that the draft loss through the boiler setting, boiler stack and dust collector will be about 3.4 in. of water. The available draft from the stack is about 3.6 in.

The necessity of silent operation limited the selection of pulverizers to units of the high-speed type. The four units, one for each boiler, operate largely on the attrition principle. Each has a rated capacity of 5,500 lb. per hour when pulverizing coal containing five per cent moisture.

The pulverizer units are on the firing floor level, with their foundation, which is of special soundproof construction, resting on solid rock. A 10-in. dia. pipe carries the coal air mixture from each unit to a turbulent-type burner in the front of the boiler 7 ft. 4 in. above the furnace floor. There are no interconnections between the mills, each unit serving but one boiler.

Primary air is a mixture of air and boiler gases taken from the front of the combustion chamber just below the bottom row of boiler tubes. A damper in the 10x10-in. primary air duct permits air to be mixed with the hot gas for temperature control before being drawn into the pulverizer by a fan integral with the unit. The hot mixture of air and gas, which at 200 per cent rating constitutes about 15 per cent of the total air needed for combustion, helps the pulverizer by drying the coal.

The furnace is 12 ft. 9 in. wide by 16 ft. 9 in. long and has an average height of about 17 ft. 4 in. This gives a combustion space of 3,700 cu.ft., which at 200 per cent rating results in a heat liberation of 15,500 B.t.u. per hour per cubic foot. This liberal combustion space should result in low furnace maintenance cost and smokeless combustion.

The table contains the guarantees of the combustion equipment and is based on coal of 13,500 B.t.u. containing 71 per cent fixed carbon, 17 per cent volatile, and 7 per cent ash. In considering the efficiency figures given in the table it should be noted that heat-recovery equipment has not been installed.

Coal is received by truck and, normally, dumped through a street coal hole into a hopper large enough to hold slightly more than one truck load. A 24-in.-wide

NOT MANY YEARS AGO *pulverized coal in congested areas was considered out of the question, because of the ash and soot nuisance created in the immediate neighborhood. This method of firing the boilers in the New Yorker Hotel, located as it is in the heart of a business district, may be taken as an indication that the fly-ash problem has largely been solved.*

feeder apron conveyor removes the coal from this hopper and delivers it over a magnetic separator to a 25-ton-per-hour crusher, which discharges the crushed coal to a 16-in.-wide distributing belt.

There are three concrete bunkers having a total capacity of 500 tons. Each of the two bunkers nearest the engine room feeds one boiler, while the end bunker feeds two boilers. Additional street coal holes have been provided which permit the delivery of coal direct to the bunkers in case of a breakdown of the coal-handling equipment.

From the bunkers the coal is fed to the pulverizers through automatic recording scales, each having capacity to weigh three tons of coal per hour in 200-lb. lots.

Ash that collects in the bottom of the furnace is hoed out through four 30x21-in. openings into hoppers built into trenches in front and back of the boilers. It is removed from the hopper through an 8-in. cast-iron suction line of a pneumatic ash-handling system, and delivered to a steel tank of 950 cu.ft. capacity located above a driveway on the street level. The ash is dumped from the storage bin into trucks specially constructed to handle the fine pulverized fuel ash. A 3,000-c.f.m. fan creates a suction of 54.4 in. of water in the ash storage tank through a 10-in. dia. pipe and dust collector. The fan discharges into the stack flue. This ash-handling system also receives the ash collected by the dust-recovery equipment located on the building roof.

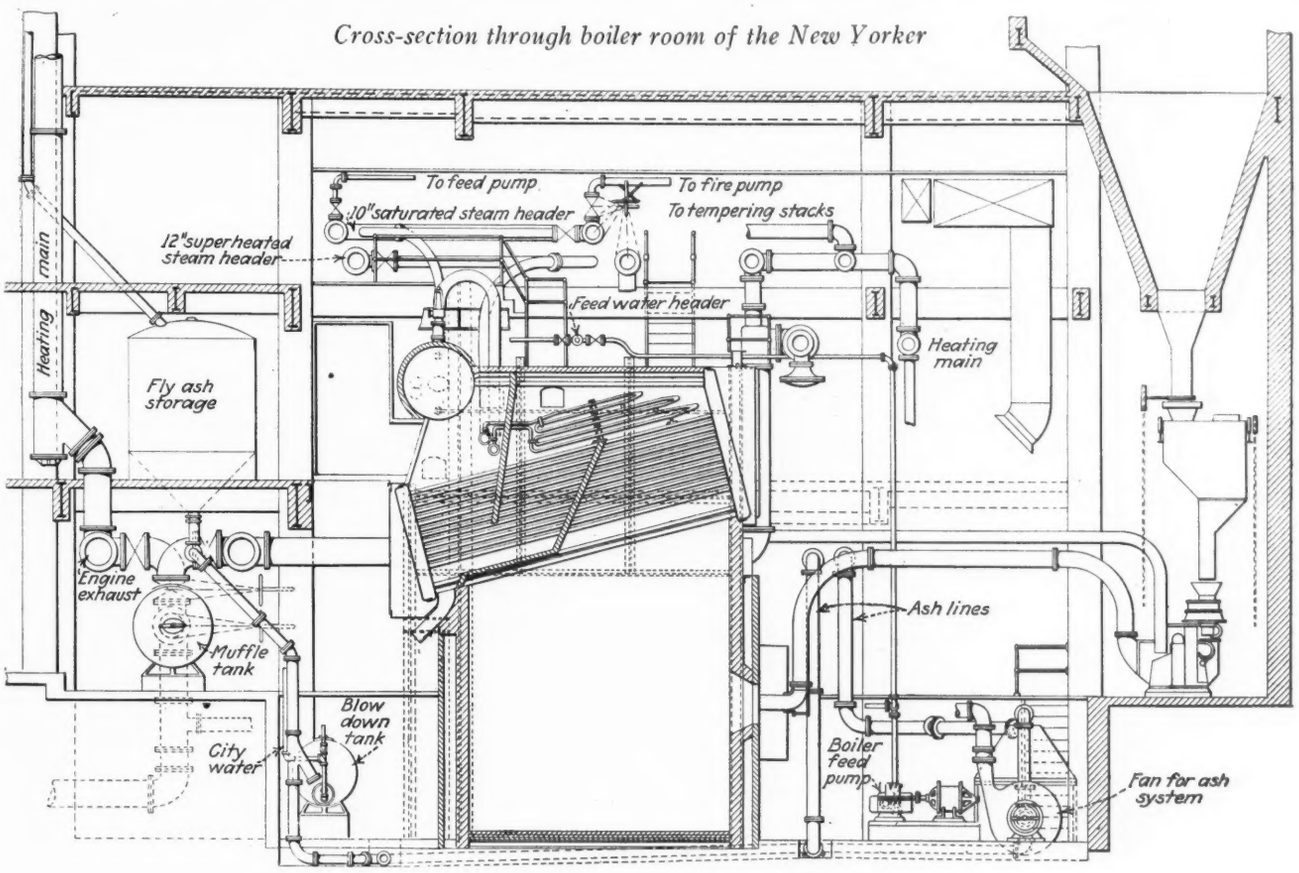
In connection with the use of pulverized coal in the boiler furnaces, it was realized that some efficient type of dust collector or eliminator would have to be installed to handle the boiler gases and eliminate the finely divided ash, commonly referred to as fly ash, which is carried with the boiler gases, and which, if permitted to escape to the atmosphere, would create a considerable nuisance both in the surrounding section of the city and also in the hotel itself due to infiltration through the windows.

It was desired that the equipment be simple in construction and operation and require a minimum of attention. It had to be of moderate weight, as the structural steel work had all been designed and in fact was being fabricated at the time the selection of the collector was made. In addition, an apparatus was required which would occupy a comparatively small space and be of moderate height, so as not to mar the appearance of the hotel. Furthermore, the collector had to be of a type showing a low draft loss, so that it might operate under natural-draft and thereby eliminate induced-draft fans and motors, reducing the initial cost as well as the annual operating expenses. Finally, a high recovery was deemed essential, and as a matter of protection a definite stated efficiency and guarantee was demanded.

The dust collector selected is of the baffle-plate type, specially designed for low-draft loss. The only space available for the apparatus was on the roof of the hotel tower. A stub stack from the collector outlet and a bypass to take care of possible overload during severe winter weather were installed.

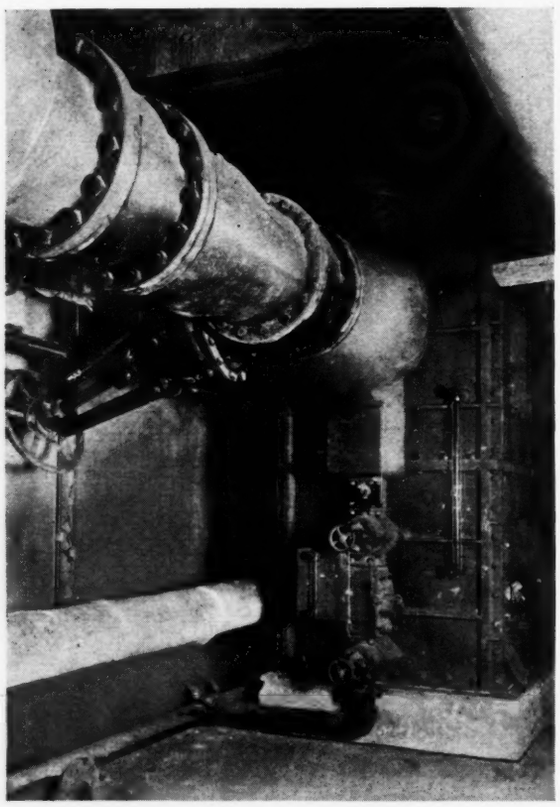
The dust collector has a normal rating of 50,000 cu.ft. of gas per minute, this being the maximum volume anticipated in regular service. The guaranteed efficiency is 70 per cent, by which is meant that 70 per cent of the weight of dust entering the collector will be trapped regardless of its fineness or screen analysis. An efficiency of this order, together with the operating characteristics of the collector, is expected to eliminate any dust nuisance, for the reason that the remaining percentage of dust escaping to the atmosphere is extremely fine, light and flocculent. Accordingly, it will rapidly diffuse into a large volume of air and be carried for great distances before final settlement.

Cross-section through boiler room of the New Yorker



Ordinarily, the dust loading of the gases is from 1 to 1½ grains per cubic foot of gas. Assuming the lower figure, it will be evident that approximately 5 tons of fly ash is carried by the stack gas for a 24-hr. day, which, without the use of a collector, would be discharged to the atmosphere.

The dust trapped in the collector is continuously removed by a series of special conveyors, which discharge into an off-bearing conveyor, the latter discharging to a down spout leading to a 450-cu.ft. auxiliary ash tank located in the third cellar. The fly ash is removed from this tank by a pneumatic ash system and delivered to the main storage bin. The installation of the auxiliary tank was necessary because the building structure made it impossible to pipe the ash direct to the main storage tank.



Above—One of the two deäerating type feed water heaters, which are equipped with oil separators. They each have capacity to store 123 cu.ft. of water

Right—The dust-collecting equipment installed on the roof of the hotel. The mechanism on the left side of the collector is for shaking the dust off the collecting plates and allowing it to drop into the transverse screw conveyors. The transverse conveyors deliver to a main collecting conveyor located along the back of the collector

Distribution of Steam from Boilers

Superheated steam is used only by the engine-generator sets and in the engine driving the CO_2 compressor. It is delivered from the superheaters through 8-in. leads to a 12-in. ring header that makes a complete circuit of the engine and boiler room.

There is also a 10-in. ring header for saturated steam. Saturated steam at boiler pressure is delivered from this header to the turbine drives on the fire pump, spare water pump and boiler feed pump. These turbines exhaust to the low-pressure header.

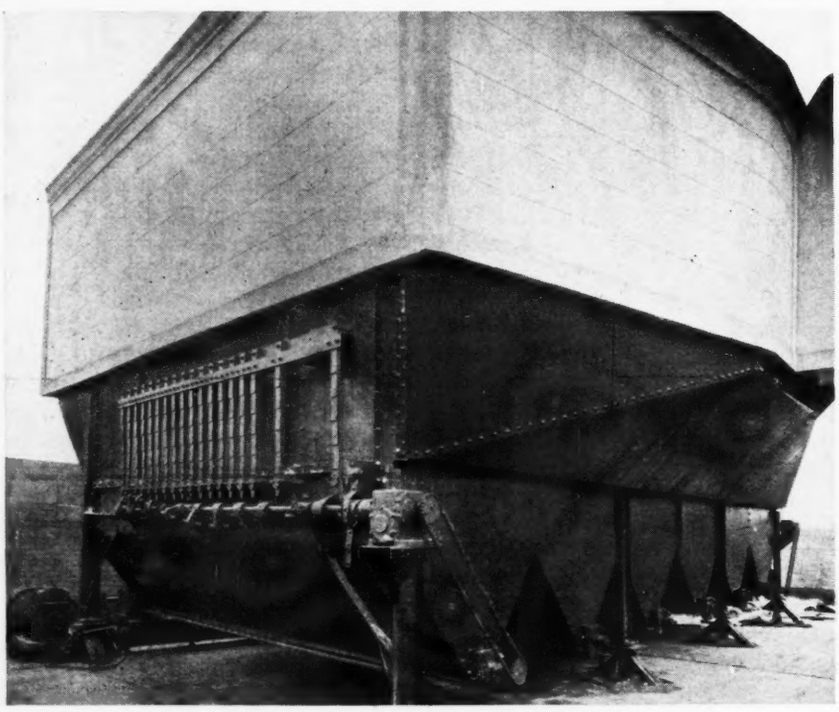
Steam for the kitchens, pantries, laundries and valet service is supplied from the saturated-steam header through a 4-in. line. The pressure is first reduced to 100 lb., at which it is used in the laundry and valet service. A branch from this line furnishes steam at 40 lb. pressure to the kitchens and pantries through a 4-in. reducing valve.

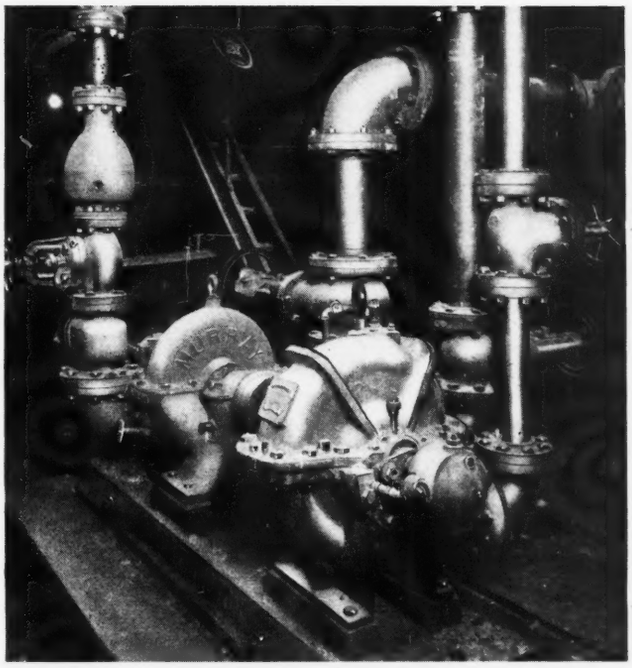
GUARANTEED PERFORMANCE OF UNIT PULVERIZERS

Boiler Rating, Per Cent	Flue Gas Temperature, Deg. F.	CO_2 Content	Boiler Efficiency, Per Cent	Lb. Coal per Boiler per Hour	Input to Motor Assuming 85 Per Cent Motor Eff.
100	450	13½	78	2,070	22.5
150	505	13½	78	3,100	16.5
180	525	13½	79	3,770	14.3
200	540	13½	77	4,250	13.2

The tempering stacks in the air-conditioning systems and at the inlet to the supply ventilating fans are supplied from the saturated-steam header. The pressure is first dropped to 40 lb. through a 6-in. line and later reduced to 5 lb. This 40-lb. line is also connected to the kitchens for use in case of trouble on the main kitchen supply line.

A connection between the saturated-steam header and the low-pressure exhaust header supplies low-pressure steam for building and hot water heating when the supply of the engine exhaust does not meet the demand. The steam is first reduced to 40 lb. by two 6-in. dia. valves and then to 3 lb. by a 12-in. dia. reducing valve.





The steam-driven 340-g.p.m. boiler-feed pump installed on the lower level of the boiler room. It is driven by a 75-hp., 2,400-r.p.m. turbine

Low-pressure condensate from the building-heating system and hot water heaters is returned to the receiver of the centrifugal vacuum pumps, which deliver the returns to an open feed-water heater. High-pressure condensate from the kitchen, laundry and drips from the steam piping are returned direct to two open feed-water heaters.

Steam from the low-pressure exhaust header is used in the feed-water heaters to heat the condensate to 210 deg. F. From the heater the water is delivered by gravity to steam- and electric-driven 340-g.p.m. boiler-feed pumps.

Boiler Feed System

The boiler-feed system is also tied in with the high-level water storage tank, whose elevation is such that water can be supplied direct to the boilers without going through the feed pumps.

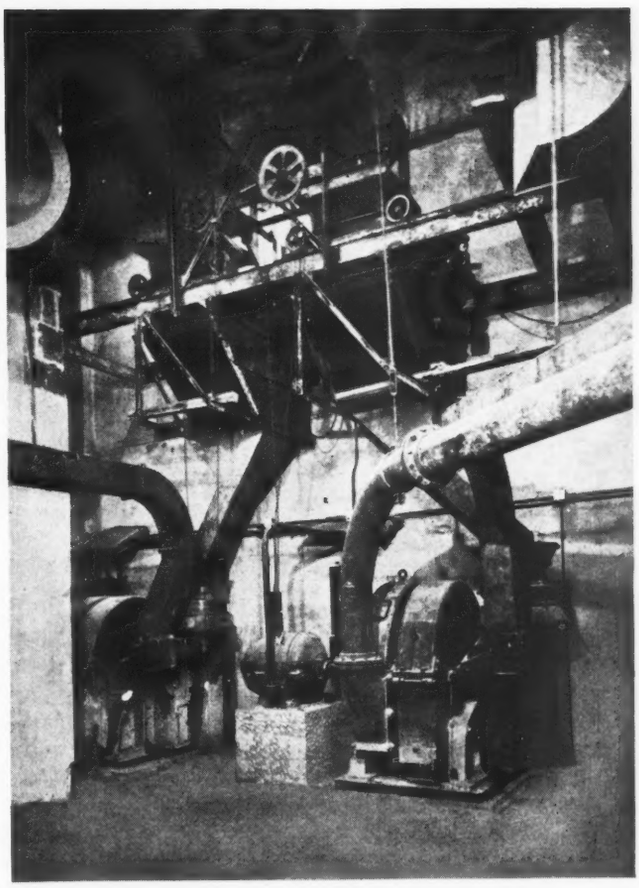
The feed pumps discharge into two 4-in. feed-water headers, one for normal and one for emergency service. Water is fed to the boilers through automatic level regulators, and the boiler-feed pumps are controlled by automatic pressure regulators. All of the feed-water piping is extra heavy brass pipe.

A 5,800-gal. hot-well tank near the Diesel engine takes care of the difference between the quantity of water returned to the feed-water heater and the immediate boiler demand. It also receives the circulating water discharged from the Diesel engine. A 150-g.p.m. pump draws water from the hot well and delivers it through a float valve to the feed-water heater as required, or to the city pressure hot-water system. It is intended that the hot-well pump will be kept in continuous operation, and in case there is no demand for water either by the boiler-feed or hot-water systems, the pressure builds up, opening a relief valve through which the water discharges back to the hot well.

Boiler blow-down is discharged to a blowoff tank through which city water is circulated in pipe coils. The city water cools the blow-down before discharging to the sewer, and the heated water supplements the supply to the water heaters.

Automatic combustion control equipment regulates the coal feed so as to maintain practically constant steam pressure, and proportions the air flow to the fuel feed. To further insure efficient boiler performance instruments record flue gas temperature, CO_2 and both superheated and saturated steam flow. These instruments, together with draft and pressure gages, are mounted on individual boiler panels.

A recording and integrating Venturi meter has been installed to measure the total water feed to the boilers. These instruments together with the coal weights permit the calculation of individual boiler efficiency as well as the over-all boiler room efficiency. The records drawn by these instruments also permit the chief engineer to see at a glance the actual operating conditions that have existed and to place responsibility for careless or incorrect operating methods.



View of the coal-pulverizing units, showing the automatic scales for weighing the coal feed to each boiler

These units of 5,500 lb. capacity are driven by direct-connected 50-hp., 1,150-r.p.m. direct-current motors

In the engineering of this boiler room it was kept constantly in mind that continuous twenty-four hour per day operation for three hundred and sixty-five days per year had to be assured. It is felt that the design has been such as to permit repairs without interfering with the regular service of the plant, that every reasonable safeguard has been considered to insure continuous operation, and that the possibility of a general shutdown is very remote.

THE HEATING SYSTEM *of a hotel differs but little from that to be found in other types of buildings of similar size. The use of extended surface-type radiators and radiator inclosures, though unusual in hotels, is in line with present trends.*

HEAT FOR 3500 ROOM GUESTS

BY R. B. PURDY
Assistant Editor of Power

THE heating service demanded of a hotel by its guests differs in one fundamental respect from similar service furnished to other buildings. Heat must be available at all hours and in such quantities as will satisfy the individual's idea of comfort. Provision must be made for those who would be dissatisfied with any automatic arrangement or centralized control that would prevent them from heating their rooms to 80 deg., if they want, or from keeping their rooms comfortable with the windows open. This service requirement has been kept uppermost in designing the heating system that serves the 3,500 room guests of the New Yorker.

Heat, however, must provide for many more than just the room guests. It must be furnished for those who utilize the restaurants, ballroom, barber shops and lobby, and for the many employees needed for the hotel's operation. In all, it is estimated that during a busy day approximately 30,000 people will use this building. For these public rooms and work spaces, automatic control of the heat supplied can be made to maintain a room condition comfortable to the majority, and will result in substantial economies for the hotel. Such control has been provided.

Steam for heating is obtained from the exhaust of the engine-generator sets and the engine-driven CO_2 compressor. At times of high heating load and low electrical load, the supply of exhaust steam can be supplemented with live steam reduced to the exhaust pressure by primary and secondary reducing valves. The secondary reducing valve is set to maintain a pressure of three pounds in the exhaust header.

As indicated in previous articles, the live steam is generated at 175-lb. pressure in 6,500-sq.ft. boilers, which are fired with pulverized coal.

The main exhaust steam header is 20 in. in diameter, and after passing through a muffler tank in the fourth cellar rises to the roof of the building, where it terminates in an atmospheric relief valve. Except for expansion joints and fittings, this line is welded throughout. At the pipe space between the 24th and 25th floors an 18-in. diameter connection is made to the 20-in. riser through which all of the steam for heating the hotel guest rooms is taken. In this pipe space headers and branch lines deliver steam to the risers, which feed up to the 42nd floor and down to the 5th floor, inclusive. To feed the radiators in the guest rooms, 73 risers and 93 downcomers are supplied with steam from the branch headers, located in the 24th floor pipe space.

In the fourth cellar a 12-in. branch from the main 20-in. exhaust header supplies steam for the direct and indirect heating of all four basements and the first to fourth floors, inclusive. Twenty-four risers, originating in a header in the second cellar, carry steam to the direct radiation installed in the first four floors. An 8-in. branch from the heating main in the fourth cellar furnishes steam to the indirect heating system that serves all of the basement floors. Live steam reduced to five pounds is also available to this system when there is not sufficient exhaust. Exhaust steam has not been made available to all of the indirect heating or to any of the air

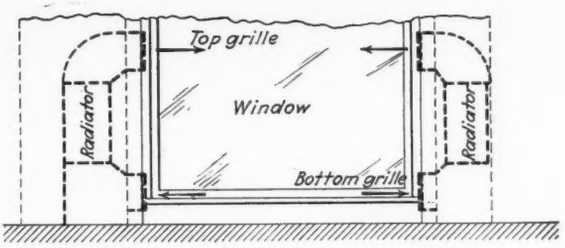


Fig. 1—Radiators installed in walls when low sill prevented installation under the window

conditioning because the additional cost of piping did not seem to be justified by the savings in operating costs.

Direct radiation has been installed under the window-sills throughout the building. The radiators are of the extended-surface type and consist of horizontal return-bend copper tubing swedged in at the steam and return ends for standard-size pipe threads. The copper tubing has two or three bends, depending upon whether the inlets and outlets are to be at the same or opposite ends. The copper extended surface is attached to the return-bend tubing. In selecting the size of radiator for a given location, little significance has attached to the actual surface, the manufacturers' rating of equivalent square feet, based on 240 B.t.u. per square foot, having been used throughout. Thus while there has been installed a total of 103,106 sq.ft. of equivalent radiation, this figure is meaningless if used to visualize the actual size and weight of the radiators installed.

In all of the guest rooms metal radiator inclosures have been provided. These are fastened to the metal window sills and supported by legs resting on the floor. The radiators, in turn, are provided with legs which rest on angle-iron supports integral with the metal inclosures. The front grilles of the inclosures are arranged so that they may be readily removed, making the radiators, valves and traps easily accessible for maintenance work. For all of the radiators in the guest rooms there are modulating-type valves with stems extending through the inclosure so that each guest can adjust the amount of heat to meet his own ideas of comfort. Thermostat traps, as is usual practice, have been provided at the outlet of all direct and indirect radiation.

In several cases special treatment of the radiator installation and arrangement of the inclosures was necessary. The sills of the windows in the beauty parlor are so low that room was not available for the required amount of radiation even though extended surface radiators were used. Fig. 1 shows how this situation was handled, the radiators being installed in the wall on both sides of the window, and inlet and outlet ducts provided to permit air circulation.

Because of the architectural treatment of some of the public rooms, it was undesirable to provide grilles at the bottom of the radiators. To provide for the circulation of air through the radiators the arrangements shown in Fig. 2 were used. Glass screens in front of the windows separate the cold air next to them from the hot air in the room and provide paths for the air to circulate down over the radiator surfaces.

For each square foot of equivalent radiator surface four square inches of inlet grille and five square inches of outlet grille have been provided for these special arrangements.

Of the 103,106 sq.ft. of direct radiation installed, 27,566 sq.ft. furnishes heat to the guest rooms in the upfeed section from the 25th floor to the 42nd floor. In the downfeed section from the 24th floor to the fifth floor, inclusive, 64,000-sq.ft. has been installed and 11,153 sq.ft. in the first four floors. This amount of radiation is contained in 4,902 radiators. In addition to the radiators installed under every window, each guest's bathroom has been provided with a small amount of radiation. For the inside baths there is 3½ sq.ft., and for the outside baths from 8.19 to 12.8 sq.ft., depending upon the size of window and room.

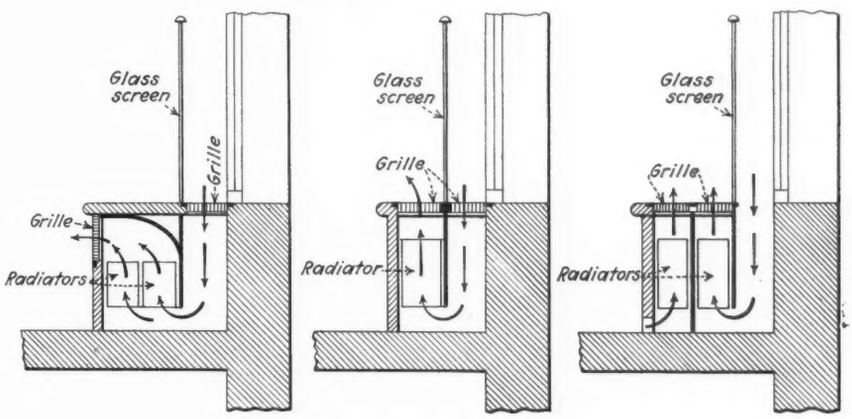


Fig. 2—Three methods used to inclose radiators when marble front is necessary to harmonize with the room decorations

Returns from the radiators located on the 42nd to 24th floors are carried down in as many return lines as there are risers to the pipe space on the 24th floor, where they feed into the nearest return line of the downfeed system.

On the fourth floor the 93 return lines of the downfeed system are gathered in groups of four or five into eighteen headers that feed through downcomers to a main collecting header in the second cellar. This header

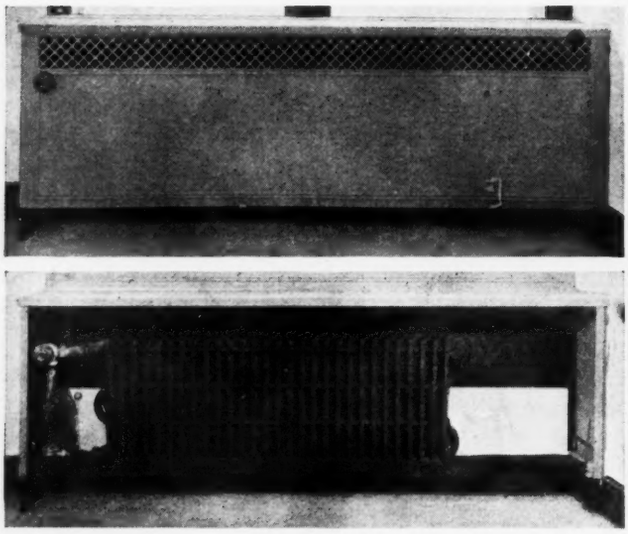


Fig. 3—Radiator installation in guest rooms

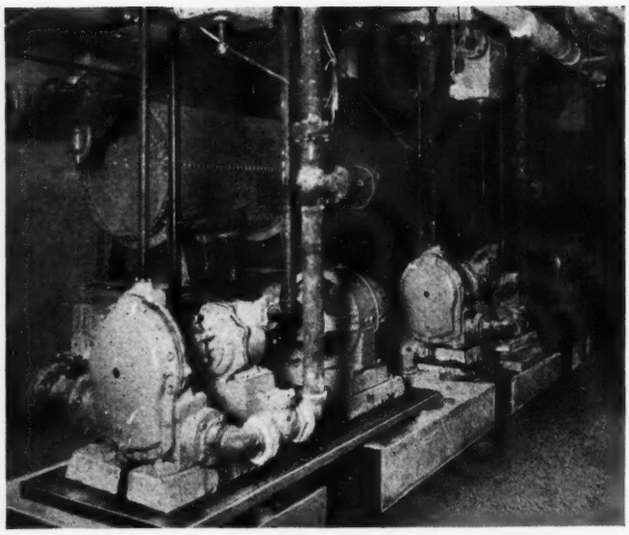


Fig. 5—Receiver tank and vacuum pump installation

feeds direct to the vacuum pump receivers, located in the fourth basement. Returns from the indirect heating stacks, and from the direct radiation in the first four floors, are collected separately into the 6-in. main to the vacuum pump receiver tanks.

Two receiver tanks, each having capacity to hold 270 gal. of condensate, have been installed in the fourth basement. They are served by three electrically driven centrifugal vacuum pumps capable of maintaining a 10-in. vacuum in the receiver tank and delivering the condensate against a 20-lb. pressure to the feed water heater. The pump piping is arranged so that either of the three pumps can remove condensate from both of the two receiver tanks, giving a flexible system that should take care of any emergency. The receiver tanks and vacuum pumps also handle the condensate from the hot water heaters. An orifice-type meter has been installed in the discharge header from the pumps, from which the steam used for both building and hot water heating can be determined.

Normally the returns from the heating system will be collected in one of the receiving tanks and the returns from the hotwater heaters in the other. However, in case one of the tanks has to be taken out of service because of leaks or cleaning, the remaining receiver has sufficient capacity to handle both loads.

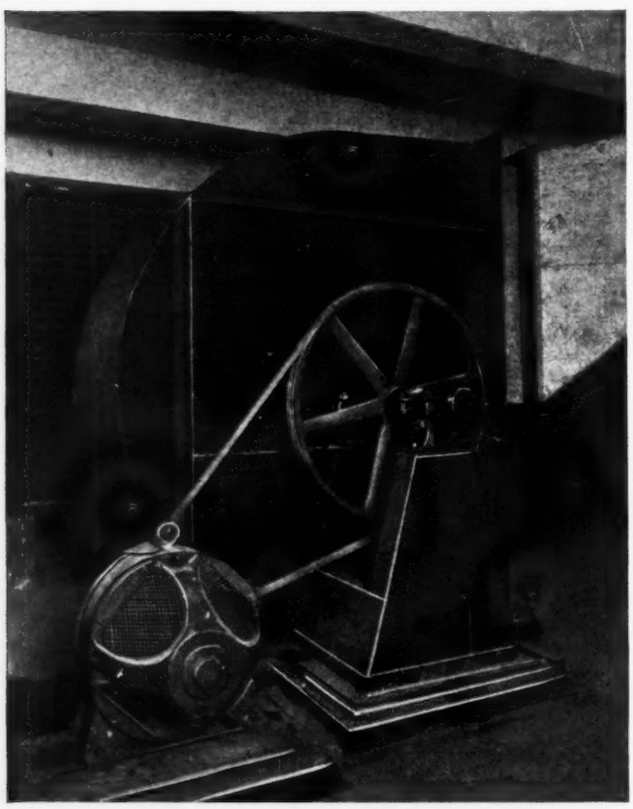


Fig. 4—One of the fans serving the indirect heating system, showing heating stack at the fan inlet

Indirect Heating

Thermostatically controlled valves have been provided for all of the radiators installed in public rooms, and for the heating stacks of the indirect heating system. The control on the heating stacks has been arranged so that the steam is first turned on to the stack nearest the fresh-air inlet. If more heating is required, steam is admitted to the second and third stacks, and so on until all of the heating surface is in service. This arrangement eliminates possibility of any of the stacks becoming frozen, and also gives closer control. Indirect heating has been provided for the main lobby, all of the fourth floor, and the bank, and for all of the rooms located below the street level. In addition to this, complete air conditioning has been provided for the main dining room, grill room, tea room, banquet hall, ball room, private dining room and barber shops, a description of which is given in another article. Nine fans having a total capacity of 221,500 c.f.m. have been installed to supply air for the indirect heating system.

The tempering stacks installed at the inlet of all supply fans consist of $1\frac{1}{4}$ in. diameter outside radiating pipes, which are rolled into the outlet section of a header at one end only, their other end being closed. Smaller pipes inside of the radiating pipes extend from the inlet section of the header through the outlet section almost to the closed end of the outside pipe. Thus the steam flows through the inside pipe and returns with the condensate through the annular space between the inside and outside pipes into the outlet section of the header. A total of 19,000 sq.ft. of heating surface has been placed in front of the supply fans of both the air-conditioning and indirect heating systems.

WHILE THE CITY SWELTERS

By R. B. PURDY
Assistant Editor of Power

TO PROVIDE COMFORT *five air washers, 166 tons of refrigeration, and thirty-two fans, having a total capacity of 900,000 c.f.m., have been installed. Applications of air conditioning such as this serve to illustrate the growing demand for year-round comfort, which first became evident in the theater and has spread to industry, public buildings, and even the home.*

COMFORT is one of the services that has been uppermost in the minds of the engineers responsible for the design of the New Yorker Hotel, and since the temperature and moisture condition of the surrounding atmosphere largely determines personal comfort, provision has been made to control these factors in many of the public rooms.

Experience has shown that unless special precautions are taken, the dining rooms of a hotel during the summer are the most uncomfortable of all the public rooms. This is because in addition to the heat liberation ordinarily encountered a considerable amount of heat and moisture is given off by the foods being served. That the guests of the hotel may enjoy their dining to the greatest extent, air-conditioning equipment is installed that will maintain comfortable conditions the year around.

Five separate conditioning systems serve, respectively, the main dining room and tea room, the banquet hall, grill room, main ballroom and eight private dining rooms, and barber shop. Each of these systems, consisting of air washer, supply and exhaust fans and a central cooling unit, embodies the same general design features, but differs in size and arrangement.

The air washers and fans for the main dining room and ballroom are in a fan room on the fourth floor, those for the banquet hall and grill room on the second basement floor, and those for the barber shop on the third basement floor.

The conditioning equipment has been designed with sufficient capacity to maintain an inside temperature of 75 deg. and a relative humidity of 50 per cent, even when the outside temperature is 95 deg. and the relative humidity is 60 per cent. To accomplish this means had to be provided to remove all of the heat liberated in the conditioned rooms from such sources as electric light, food, body heat, and also the heat transmitted through the walls from the outside or neighboring unconditioned rooms. In addition to removing sensible heat, a considerable amount of moisture must be taken out of the air to maintain the best comfort conditions, and this required additional cooling capacity.

To remove this heat one 166-ton CO_2 refrigerating unit has been installed in the fourth sub-basement. The CO_2 refrigerant expands through water-cooling coils having 7,000 ft. of cooling pipe, and capable of cooling 900 g.p.m. of water to 42 deg. The diagram shows the cooling-water system. Two 900 g.p.m.

pumps deliver the cooled water to the air washers. The head that these pumps develop must be sufficient to overcome pipe line friction and elevate the water to the highest air washer, which is on the fourth floor. As the various air washers are on different floor levels, the pressure under which the cold water is delivered to the washer units would vary unless some kind of regulating device were installed. For proper operation of the air washer the cooling water should be delivered at a constant low head.

The regulating means employed makes use of a closed receiver tank from the side of which an open drain carries the overflow water back to the cooling coils in the sub-basement. The receiver is high enough above the air washer unit to provide the head of water required. Thus there is a continuous circulation of water which is independent of the varying demands of the air washers.

At each air washer a low-head pump takes water from the air washer reservoir and recirculates it to the atomizing mechanism. As this recirculated water is warmed by the air passing through the washer, cold water from the receiver tank is admitted to the pump suction through a three-way valve under the control of a thermostat located in the air-discharge duct of the washer. Overflow water from the air washer occasioned by the admission of cold water to the low-head pump returns to the water-cooling coils through the same line carrying the overflow from the receivers.

The cooled water from the low-head air-washer pump is directed by a nozzle at the center of a revolving cone-shaped disk. The periphery of the disk is studded with $\frac{1}{8}$-in. dia. rods about 2 in. long and set at an angle of about 45 deg. The water thrown out from the disk by centrifugal force is broken up into a fine spray as it hits the rods. The disk is driven at 1,750 r.p.m. by a totally inclosed motor. In some of the air washers one motor with a disk at each end of the shaft is mounted in the center of the air stream. In others two smaller motors and disks are used.

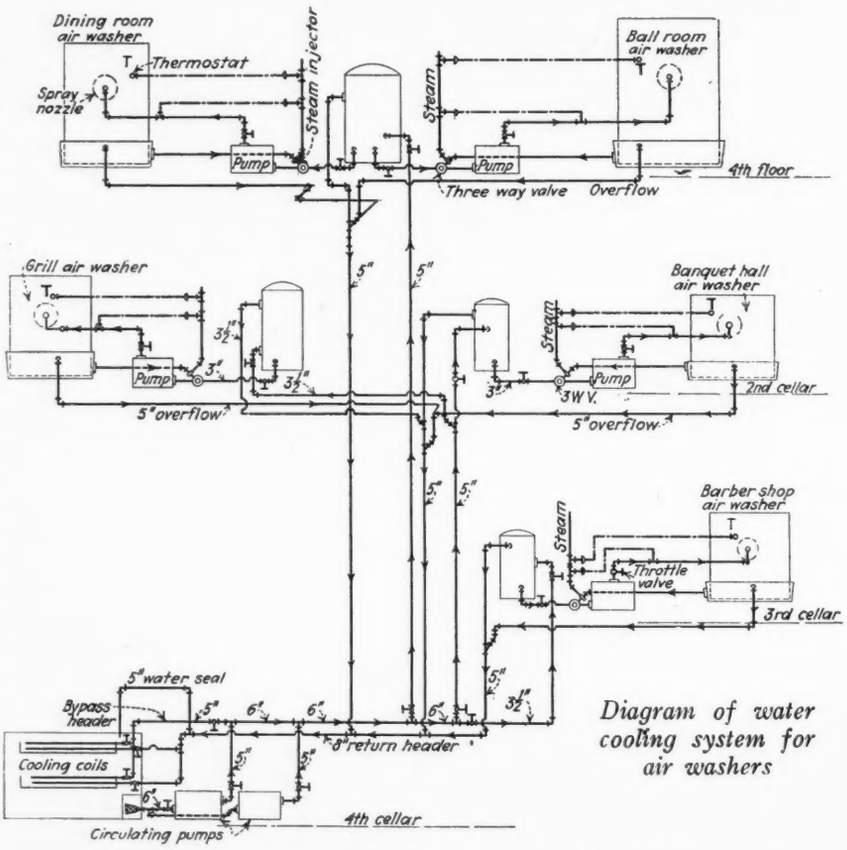


Diagram of water cooling system for air washers

Five supply fans, one for each system, draw a mixture of exhaust and fresh water through the spray in the air washers and deliver it to the supply grilles of the various rooms. In passing through the air washer the air is cooled to within a few degrees of the water temperature, which the thermostats maintain at about 56 deg. Air at this temperature is too cool to discharge into a room, as the resulting draft is both uncomfortable and dangerous to health. Therefore, it must first be tempered. This is usually done by mixing some of the warm exhaust air with the washed air. In this installation, however, all of the supply air goes through the washers to eliminate from the conditioned air all possibility of odor, and steam-heated tempering stacks at the outlet of the washers are provided. This freedom from odor has, of course, been secured at the cost of increased refrigeration and steam.

The air supply to washers is partly filtered fresh air and partly air returned by exhaust fans. Remote-controlled dampers are arranged so that the percentage of fresh air can be changed from 50 to 25 per cent as required by outside weather conditions. Tempering stacks at the inlet to the washer heat the air just enough to prevent freezing of the water in the washer during winter months.

It is expected that the inlet tempering heaters for the banquet hall and grill room will not be used to the same extent as the other heaters, as the air supply to them is first taken through an air space in the ceiling above the boiler room. It is intended that the air drawn through this space will act as a heat insulator between the boiler room and the floor above by absorbing the heat transmitted through the boiler room ceiling.

The capacities of the supply and exhaust fans, and the number of air changes per hour, are given in the table. The capacities of the supply fans were not based on any arbitrary air-change factor, but were based on the temperature rise desired between inlet air and required room temperature. The exhaust fan capacities are in all cases slightly less than the capacity of the corresponding supply fan. This was done in order that there would be a slight pressure in these rooms, thus forcing air leakage rather than infiltration from surrounding warm rooms.

Control of the air-conditioning system is by thermostats. A thermostat at the inlet to the air washers operates to admit steam to the inlet tempering stack when the air temperature approaches the freezing point.

The temperature of the water delivered to the air washer is controlled by a thermostat actuated by the air leaving the washer. It is set to close both the steam- and cold-water admission valves when the air temperature is 56 deg. If the temperature falls the thermostat admits steam to a mixing nozzle in the air-washer pump suction line, thus heating the water to the washer. If the tem-

perature of the air rises, a three-way valve is operated, admitting cold water from the refrigerating unit.

Steam admission to the tempering stacks at the supply fan inlets is controlled by thermostats in the ducts after the heaters and in the conditioned rooms.

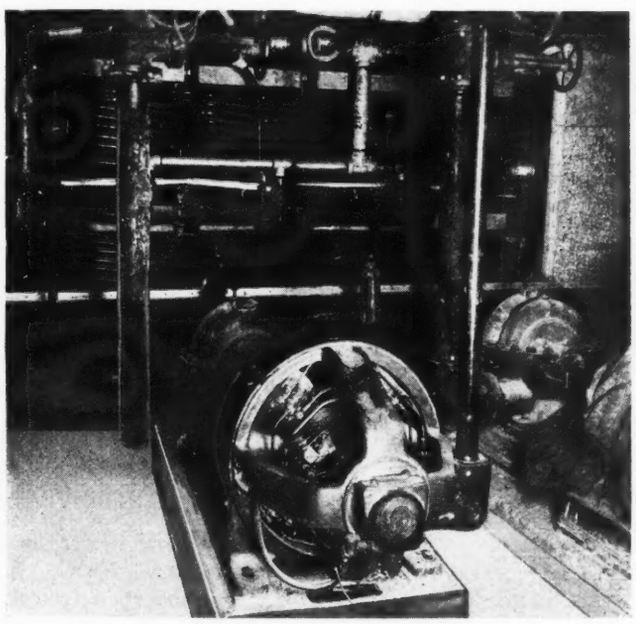
After the cooling equipment for these five air washers had been purchased it was decided to provide air conditioning for the Fountain Room. The refrigerating unit purchased did not have sufficient spare capacity to take care of the added load so a somewhat different arrangement had to be made for this unit.

This new air washer required 32 tons of refrigeration, which capacity has been obtained from the main 120-ton units using the refrigerant in separate brine-cooling coils. The brine is used in a closed system to cool water in a closed tank located on the floor below the air washer.

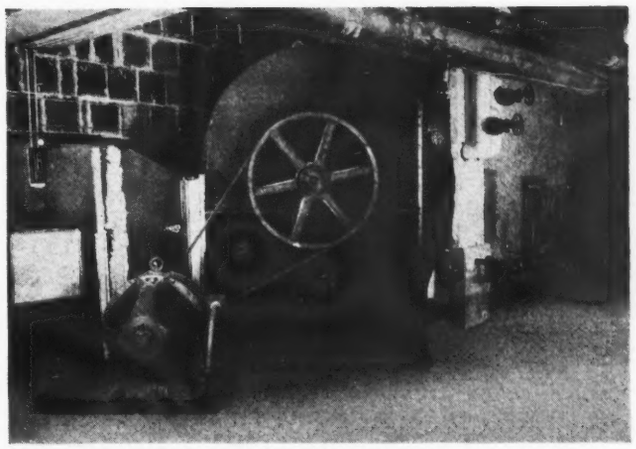
The air washer is of the type used in the other system, but the pump that supplies water to the spray is located on the floor below and has its suction connected to the bottom of the closed water-cooling tank. The bottom of the air-washer reservoir is connected to the top of the tank. Thus the air washer pump sends cold water to the air washer, from where it flows back to the closed tank. As in the other systems thermostatic controls operate a three-way valve and a steam injector so as to maintain the proper water temperature.

SUPPLY AND EXHAUST FAN CAPACITIES

Purpose	Fan Capacity — Supply	Fan Capacity — Exhaust	Air Changes per Hour
Air Conditioning:			
Ballroom and private dining rooms	35,000	33,000	10
Main dining and tea rooms	23,000	19,000	12
Grill	20,000	15,000	12
Banquet hall	10,000	9,000	12
Barber shop	9,000	7,000	12
Ventilation:			
Main kitchen	50,000	55,000	..
Kitchen hood	.....	33,500	..
Kitchen storage	31,000	.....	..
Fourth basement	38,500	40,000	..
Third basement	28,000	.....	..
Main lobby	24,000	27,000	
Bank	22,000	28,000	..
Fourth floor	10,000	8,500	..
Boiler room	10,000	.....	..
Second and third basement	.....	22,000	..
Laundry	62,000	53,000	..
Pantry	.....	16,000 1,500	..
Toilet and bath room	.....	102,000 40,000 36,000	..



Coils for cooling water to air washers



One of the air washer installations on the fourth floor

The boilers, prime movers, refrigerating machines and auxiliary equipment are located in the fourth sub-basement, and therefore little opportunity exists for the natural escape of heat emitted from them. The amount of heat given off by this equipment reaches considerable proportions in spite of the amount of insulation provided. Although it is not necessary to maintain as low a temperature here as in the air-conditioned parts of the hotel, nevertheless a reasonable temperature must be maintained if the power plant operators are to work efficiently.

Boiler and Engine Room Ventilation

The air necessary to support combustion was considered to provide sufficient ventilation for the boiler room. The air supply is made up of air exhausted from the second and third basements, the main lobby, grill room and banquet hall. The two latter rooms are air-conditioned, and in using the exhaust advantage is taken of the relatively cooler air obtainable from them. In addition to these sources of supply a supply fan of 10,000 c.f.m. capacity will provide air in case any of the exhaust fans are not in operation.

The total air supply capacity amounts to between 71,000 and 65,000 c.f.m., depending upon whether 75 or 50 per cent of the exhaust is returned to air washers that condition the air for the grill room and banquet hall.

Exhaust ventilation is, of course, provided for all public lavatories and guest bath rooms. There are three fans for this purpose on the 42nd floor, and they have a total capacity of 178,000 c.f.m. This provides between 15 and 17 air changes per hour for the public toilets and about 75 c.f.m. for each guest bath room.

Each fan handles a separate portion of the building. The largest fan, 102,000 c.f.m., exhausts from the 4th to the 24th floor, inclusive. The other two fans exhaust from the basement to the 3rd floor, inclusive, and from the 25th to the 40th floor, inclusive. There are four other exhaust fans located on the 42nd, or top, floor of the hotel. They serve the laundry and kitchen.

Space for the ducts carrying exhaust air to the fans on the top floor was very much at a premium, and in one instance it became necessary to make use of the irregular area surrounding the chimney.

All of the fans are rope-driven by variable-speed motors. Both the fans and the motors are installed on soundproof bases consisting of 6-in. timber held between 1-in.-thick layers of cork. To prevent sound being carried through the duct metal, all connections to fan housings are made with canvas.

ELECTRICAL EQUIPMENT

Modern a

By F. A. Annett
Associate Editor of Power

An Adequate and Reliable Power Supply is of even greater importance to large modern hotels, office buildings, department stores and other public buildings, than to large industrial plants. The latter might put up with a short power interruption, but in a 43-story hotel like the New Yorker, with 2,500 rooms and a population of over 5,000 persons, a failure of its power supply could never be tolerated.

IN PRACTICALLY every operation in the hotel, electricity plays an important rôle. Electric power handles and prepares the fuel for power and heating; pumps the water; provides refrigeration for air conditioning, preserving foods and for other purposes; drives the fans that ventilate the building; operates the vertical transportation system; cooks food, washes the dishes and the linen; and performs many other services. In addition, the guests can be put into almost instant touch with each other or with any service in the hotel by electrically operated signal and telephone systems.

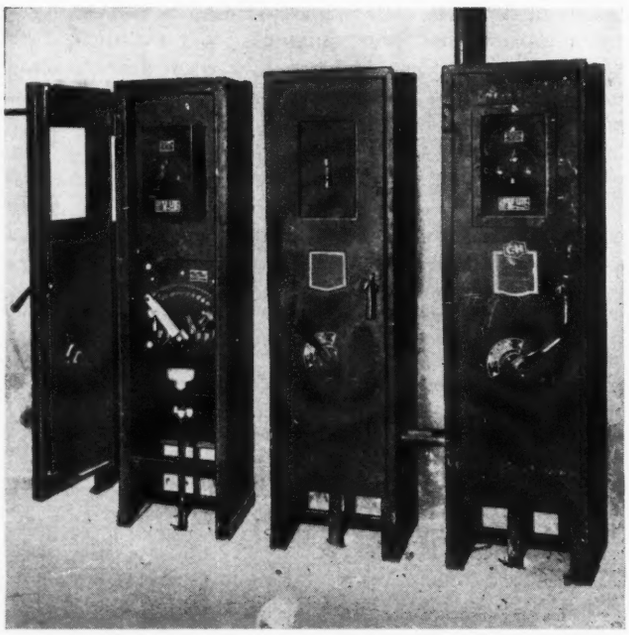
If any of these equipments fail, service to the guests is impaired and the good name of the hotel suffers accordingly. It is therefore of utmost importance that the electrical system be reliable; and electrical applications on the services must be backed by a 100 per cent dependable power supply.

This power supply is centered in the hotel's own power plant, that contains 2,575 kw. of direct-current generator capacity in five units. Four of these units are steam-driven, three having a rating of 600 kw. each and one of 400 kw. The fifth unit is rated at 375 kw. and is driven by a Diesel engine. This Diesel-driven unit not only adds to the reliability of the plant by supplying a source of emergency power, but it also provides a means of improving the heat balance.

All generators are of the 125- and 250-volt three-wire compound type, with interpoles. The four steam engine-driven units are arranged in a row, with the circuit breaker and switch panel located near the commutator end of each generator. This arrangement not only reduced the cost of wiring, but also simplified the switchboard wiring compared with placing the generator switches and circuit breakers on the main switchboard.

On account of the elevators causing wide variation in the power loads, the regulation guarantees on the generating units were made rigid. The units are guaranteed to carry the hotel load under all conditions of normal operation without any flickering in the lights. Regulation of the generators is guaranteed not to vary more than 3 per cent from a straight line, from no load to full load.

In the main switchboard there are eighteen panels, with the five generator-control and the totalizing meter panels in the center. On the right of these panels are five lighting-circuit panels on which are mounted 76 fused switches that control the lighting feeders going to the different parts of the hotel. On the left of the control section are three circuit breaker panels, on which are



Group of control units for ventilating-fan motors

mounted eighteen circuit breakers. These breakers are of the trip-free type and act both as switches and as circuit breakers on the circuits to the large motors, elevators, and the laundry switchboards. The house pump motors, air compressor motors, CO_2 compressor motors and elevator motor feeders are protected by two-pole circuit breakers. All other motors are grouped on feeders, controlled by 35 fused switches on three panels at the left of the circuit breaker panels.

All circuits leaving the switchboard go into a metal duct, with a slate bottom, above the switchboard. In this duct the conductors are carried on racks and go out in metal conduit to the various parts of the building. In the design of the feeder system, copper has been used liberally, the calculations being based on a 2 per cent voltage drop in the conductors.

A duplicate system of feeders has been provided on the elevators. The elevators are arranged six in a bank and are grouped three on a feeder. The feeder to each three elevators is large enough to supply six machines without being overloaded. In the distribution panels the feeders connect to double-throw switches in such a way that normally each group of three elevators in a bank of six will be supplied over its own feeder. In case of trouble on one feeder, throwing its switch to the opposite position will place all six elevators on one feeder. This makes the elevator service, in so far as the feeders are concerned, as nearly 100 per cent reliable as possible.

The motor requirements in a large modern hotel run into substantial figures, both in number of units and total horsepower. For all services, including the ele-

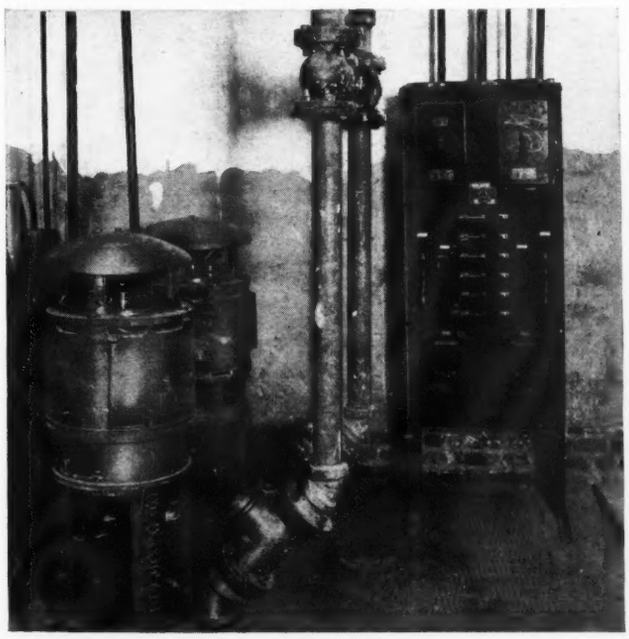
rn and Reliable --A BUILDING NECESSITY

vators and their motor-generator sets, there are more than 200 motors, totaling over 3,700 hp. All of the important motors, except those on the elevators, are listed in the table.

On the coal-handling equipment there are three motors, one each on the feeder conveyor, the coal crusher and the belt conveyor; the latter distributes the coal in the bunker. These motors are rated at 3, 20 and 5 hp., respectively.

Compound motors are used on all these services, and the control is automatic from push-button stations. Push buttons are located at the starters and at convenient points along the coal conveyor. The controls are so interlocked that the belt conveyor must be started before the coal crusher, and the crusher must be in operation before the feeder conveyor can be started. These interlocks are so arranged that in case the conveyor stops, the crusher and feeder conveyor will stop, or if the crusher stops, the feeder conveyor will stop. This prevents coal piling up at any point in the system due to improper starting of the equipment or to the failure of the equipment when in service.

The coal on its way from the bunker to each pulverizer is automatically weighed by a motor-operated weightometer. Each of the four pulverizers is driven by a 50-hp. constant-speed shunt motor. These motors have manual control of the faceplate starter type, with a magnetic contactor. Protection against undervoltage and overload is provided, the latter by temperature relays. A pulverizer is essentially a constant-speed drive, the load being controlled by the rate of coal feed.



Two of ten vertical motor-driven sump pumps with float-switch control

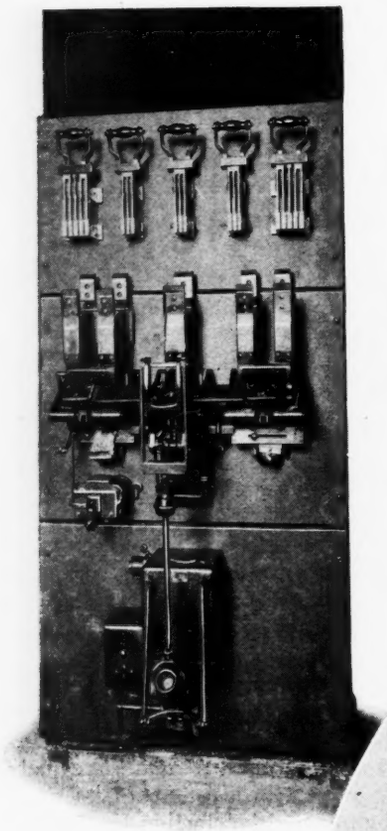
On the ash-ejector system there is a 40-hp. shunt motor driving the blower. This motor has a manual starter, in which is also combined a field-regulating rheostat. The motor is first brought up to its slowest speed, 3,500 r.p.m., by moving the starting handle to the full-on position. Field control is then obtained by moving the starting handle toward the off position. Protection against undervoltage is incorporated in the starter, and overload protection is by fuses.

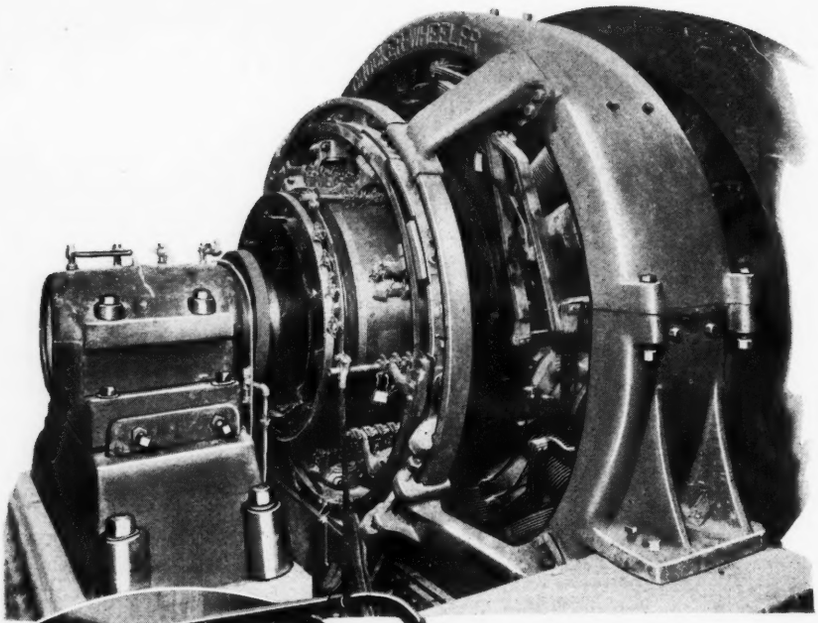
One of the boiler-feed pumps is driven by a 75-hp., 2,000-r.p.m. shunt motor. This motor has manual control, with no-voltage release, and is protected by fuses. The speed is constant, control of the boiler-feed pressure being by a governor on the pump's discharge. A 5-hp. series motor drives the fly-ash eliminator on the top of the building. Manual control is used, and as this equipment is located out of doors it is waterproof. In this application the motor drives through a gear-type speed reducer and a silent chain.

Three of the four CO_2 compressors are driven by compound motors having ratings of 200, 185 and 35 hp., respectively. Each motor is built in as part of the compressor and has its armature mounted directly on the crankshaft. These motors are manually controlled, with a field rheostat for adjusting the speed. On the two large machines overload protection is obtained with circuit breakers, and on the small machine fuses are used. Undervoltage protection is incorporated in all three controls, so that if the power fails the motors will not start again except by manipulation of the controllers.

The two cooled-water circulating pumps on the air-conditioning system are driven by 75-hp. compound motors and have manual control with fuses for overload protection. A similar arrangement is used on the two 15-hp. and the two 30-hp. motors driving the four brine pumps. On the air washers the circulating-pump motors and the spray motors have automatic control, and operate at constant speed.

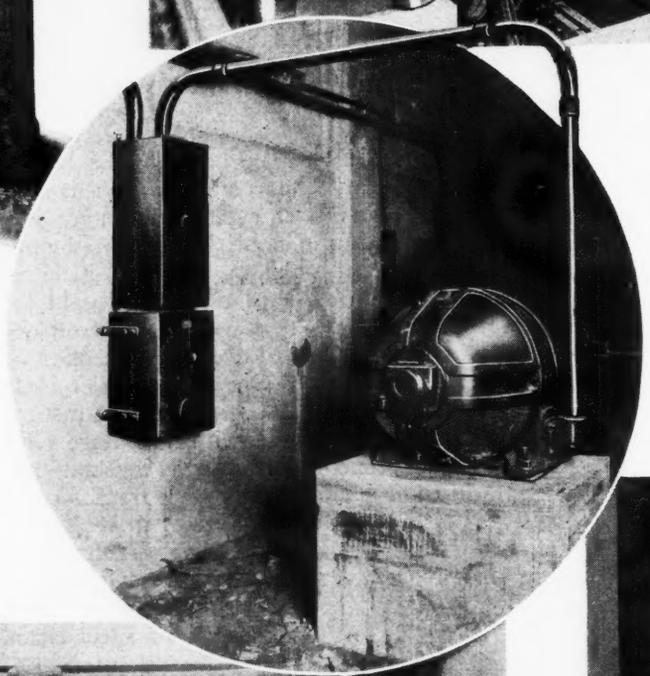
Four house pumps, one a spare, and a fire pump are provided. The fire pump and the spare house pump are steam-turbine-driven. The turbine-driven spare pump can be used to deliver water to either the low-, intermediate- or high-level tanks. It has a magnet-operated





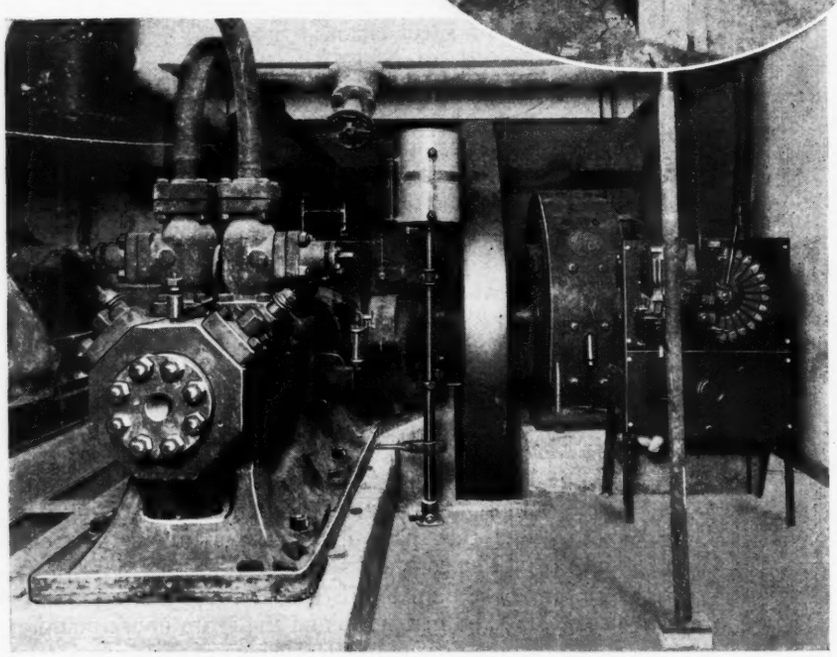
Above—One of the three 600-kw. steam-engine driven generators

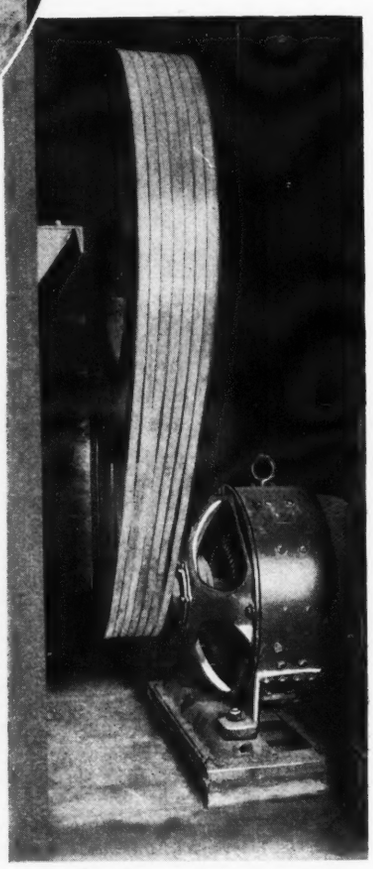
Above—A circuit breaker and switch panel is located at each generator



Below—A 75-hp. motor driving one of the exhaust fans through a multiple V-belt

Right—A 50-hp. motor with manual control drives each of the four coal pulverizers





On the air-conditioning system the CO_2 compressor is driven by a 200-hp. motor

throttle valve that permits operating on float-switch control.

The controls on the motor-driven pump are normally automatically operated by a float switch on the tanks. In case of trouble on a float switch the pump can be started and stopped from the control board by a pilot switch. High- and low-water alarms on the controls can act as a check on either float-switch or pilot-switch operation. The alarm consists of a gong and a red and a green light, the lights indicating high or low water, and the gong ringing to call attention to the condition.

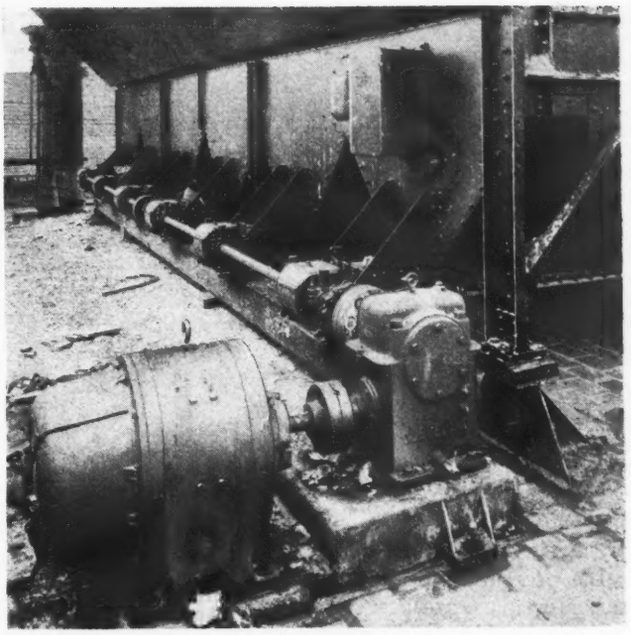
On each of the three control panels is a two-pole double-throw switch. One position of this switch connects the float switch to the motor starter, the other position of the switch connects the float switch to the turbine-valve magnet. On one of the control panels is a three-position selector switch that must be set to correspond to the number of the float switch that is intended to operate the turbine valve, before operation can be obtained. A pilot switch on the panel also allows operating the turbine valve by manual control of the valve's magnet circuit in case the float switch fails.

All the house-pump, sump-pump and sewage-ejector motors are protected against overload by inclosed circuit breakers, which serve the double purpose of switch and circuit protection. The sewage ejectors and sump pumps have automatic control, which functions from a float switch. The pumps operate in pairs and are arranged so that one starts before the other, by alternator-type float switches set for different levels. These float switches automatically change the order of starting the pumps. If No. 1 pump starts first on one pumping operation, No. 2 will start first the next time.

PRINCIPAL MOTOR APPLICATIONS*

No. of Units	Applications	Motor, Hp.	Total, Hp.	Type	Speed, R.p.m.	How Controlled	Type of Drive
1	Coal conveyor..	5	5	Comp.	1,150	Push-button	Gear
1	Coal feeder.....	3	3	Comp.	1,150	Push-button	Gear and chair
1	Coal crusher...	20	20	Comp.	850	Push-button	Belt
4	Coal pulverizers	50	200	Shunt	1,150	Manual.....	Direct
1	Ash ejector.....	40	40	Shunt	3,500 to 4,000	Manual.....	Direct
1	Fly-ash eliminator.....	10	10	Series	1,750	Manual.....	Gear
1	Boiler-feed pump	75	75	Comp.	2,000	Manual.....	Direct
1	House pump...	75	75	Comp.	1,750	Manual or float switch	Direct
2	House pumps...	125	250	Comp.	1,750		Direct
4	Sump pumps...	20	80	Comp.	1,140		Direct
1	Sump pump....	25	25	Comp.	1,750		Direct
1	Sump pump....	10	10	Comp.	1,140		Direct
2	Sump pumps...	7½	15	Comp.	1,140		Direct
2	Sewage ejectors.	20	40	Comp.	1,140		Direct
2	Brine pumps..	15	30	Comp.	1,750	Manual.....	Direct
2	Brine pumps...	30	60	Comp.	1,750	Manual.....	Direct
1	Core set.....	1.5	1.5	Shunt	1,750	Manual.....	Direct
1	Agitator.....	1.5	1.5	Shunt	1,750	Manual.....	Direct
2	Cooled-water circulating pumps.....	75	150	Comp.	1,750	Manual.....	Direct
3	Ice-water pumps	5	15	Shunt	1,750	Manual.....	Direct
2	Air-washer pumps	3	6	Shunt	1,150	Automatic..	Direct
1	Air-washer pump	2	2	Shunt	1,150	Automatic..	Direct
1	Air-washer pump	1½	1½	Shunt	1,150	Automatic..	Direct
1	Hot-well pump.	25	50	Shunt	3,500	Manual.....	Direct
3	Heating-system vacuum pumps	15	45	Shunt	1,150	Float or vacuum switch	Direct
1	CO_2 compressor	185	185	Comp.	85 to 105	Manual.....	Direct
1	CO_2 compressor	200	200	Comp.	130 to 150	Manual.....	Direct
1	CO_2 compressor	35	35	Comp.	120 to 135	Manual.....	Direct
1	Air compressor.	25	25	Comp.	1,750	Pressure sw.	.....
1	Air compressor.	10	10	Comp.	1,750	Pressure sw.	.....
1	Air compressor.	5	5	Comp.	1,750	Manual.....	Belt
2	Vacuum cleaners	20	40	Shunt	1,750	Manual.....	Direct
2	Pneumatic tubes	40	80	Shunt	1,750	Manual.....	Direct
1	Ventilating fan.	75	75	Shunt	440 to 660	Manual.....	Mult. V-belt
1	Ventilating fan...	40	40	Shunt	575 to 850	Manual.....	Mult. V-belt
1	Ventilating fan.	30	30	Shunt		Manual.....	.....
3	Ventilating fans	25	75	Shunt		Manual.....	Mult. V-belt
3	Ventilating fans	20	60	Shunt		Manual.....	Mult. V-betl
9	Ventilating fans	15	135	Shunt		Manual.....	Mult. V-belt
4	Ventilating fans	10	40	Shunt	850 to 1,275	Manual.....	Mult. V-belt
1	Ventilating fan	7.5	7.5	Shunt		Manual.....	.....
7	Ventilating fans	5	35	Shunt		Manual.....	Mult. V-belt
1	Ventilating fan	3	3	Shunt		Manual.....	Mult. V-belt
1	Ventilating fan	½	½	Shunt		Manual.....	Mult. V-belt

*In addition to the above motors there are 60 in the laundry that have a total capacity of 196.5 hp. and 28 in the kitchen having an aggregate capacity of 45 hp. Then there are many smaller motors that have been omitted from the list.



Fly-ash eliminator driven by 10-hp. motor through gear speed reducer

One of the largest motor installations in the hotel is on the ventilating fans. There are 14 supply and 18 exhaust fans, and they require about 500 hp. of motor capacity. As shown in the table, these motors range in size from ½ hp. to 75 hp., and are connected to the fans by multiple V-belts. A standard starting and overload protection unit has been used on all. It consists of a vertical steel cabinet with a manual starter in the bottom and a metal inclosed circuit breaker in the top. The circuit breaker serves the dual purpose of a line switch and overload protector. The breaker can be tripped or closed from outside the cabinet.

The motors are designed for a 50 per cent speed increase above normal by field control. The starters are of the manual type, with shunt-field regulation.

All motors and fans have their foundations insulated from the building by cork. This in combination with the multiple V-belt drives insures that no noise will be transmitted from these units through the building.

On the heating system the three combination vacuum and return pumps are driven by 15-hp. shunt motors. The control is automatic from a float and a vacuum switch. These switches are in parallel, so that the pumps will run until the water has been removed from the receiving tanks and the proper vacuum has been established. When it is desired (for instance, when the heating requirements are large) the float and the vacuum switches may be cut out and the pumps allowed to run continuously. A pump driven by a 25-hp. motor takes the water from the hot-well from which the Diesel engine circulating water is discharged and delivers to the service hot-water heater.

There are many other services that use motors other than those described in the foregoing. For example, in the laundry there are 60 motors aggregating 196.5 hp., and in the kitchen the 28 motors have 45-hp. capacity. The largest motor capacity for any service is on the elevators, and these are described in the article directly following this.

FORTY-THREE STORIES OF VERTICAL TRAFFIC

By E. W. Yearsley
Engineer, Otis Elevator Co.

A MODERN CITY is vitally dependent upon its transportation facilities, both horizontal and vertical. The great buildings typical of present-day America are possible because of their elevators. As the speed and efficiency of elevators have increased, structures have gone higher, until at the present time buildings of 100 stories or more are assured.

New York's tallest hotel, having the largest number of guest rooms, is the New Yorker, a structure 43 stories high. This hotel has 2,500 guest rooms, is located at the intersection of wide streets on a main subway line and close to a great railway terminal. It is therefore directly in the center of city activities and unquestionably will be a busy place, having a large amount of elevator traffic with particularly heavy service peaks.

A close study of the conditions in other large hotels in somewhat similar locations was made to determine as accurately as possible the elevator traffic to be expected. The various types of elevators available were investigated, and it was decided to employ the most modern and efficient equipment, thus insuring the highest quality of elevator service.

There are twelve main passenger elevators of the automatic signal-control type. Six of them run local to the 19th floor, and six run express to the 19th floor and serve all floors from there to the 39th. These elevators have the protection afforded by attendants in the cars and in addition the increased safety of automatic operation. There is no question of operating skill involved, since the movement of the elevators, as well as that of the doors, is automatic. The operators have control over the time that the elevators remain at the landings for passengers to enter and leave the cars and also have control of the car safety devices for use in case of emergency. Annoyance of passengers due to rough and possibly unsafe operation, neglect and errors of operators, and defects in signal and scheduling systems does not occur with automatic signal control elevators.

The method of determining the amount of elevator service required for a hotel is interesting, particularly as it shows that the requirements of vertical transportation may be closely predetermined. The basis of service requirements is the number of guests that the hotel can accommodate, which is a function of the number of guest rooms. It has been found that under normal conditions, with the hotel filled, there will be an average of 1.3 to 1.4 persons per guest room. When the hotel is entertaining a convention the registration is apt to increase to an average of 1.6 to 1.8 persons per guest room. The normal registration of the New Yorker for basis of elevator service was estimated at about 3,200 persons.

From data obtained from tests of other hotels, a graph of expected elevator traffic in the New Yorker was made. It shows the number of passengers that the elevators will probably have to carry throughout the day and evening.

The elevators should have a traffic-handling capacity in 5 min. equal to the maximum number of people coming to them in any 5-min. period. The period of 5 min. has been selected as the criterion of quantity of elevator service because it is the maximum length of time that can be considered if congestion in the elevator lobbies is to be avoided.

Traffic observations in the large hotels in the United States have shown similar characteristics of flow of elevator traffic. The maximum peak is always in the evening, around 6 o'clock, which, in many cases, is the checking-out hour. At this time there is heavy traffic to and from the guest rooms due to the arrivals and departures and also to traffic to and from restaurants and the outside of the building. On the basis of the normal busy registration, it has been found that the traffic from and to the main lobby floor is from 10 to 13 per cent of the registration, in 5 min., and that this is nearly equally divided between up and down service. To this must be added the peaks of traffic of restaurants and other public rooms caused by those who are not room guests of the hotel. In the New Yorker the principal restaurants are adjacent to the lobby floor and the first basement. As the ballroom and banquet hall are served by a large passenger elevator, there will be little traffic to add to the guest room traffic, which will be handled by the main passenger elevators.

Having determined the number of persons that the main passenger elevators will be expected to carry within the 5-min. peak, it is possible to determine the number of passenger elevators required to handle the vertical traffic in the building.

On account of the height of this hotel it is desirable to provide local and express elevator service. Although hotels usually have local service only, generally because they are not large enough or high enough to justify express service, express elevators have been used in some of the largest hotels from 22 to 25 stories high. Express service is, of course, more desirable the higher the building, and for a hotel of 43 stories, express and local service is virtually a necessity. It also speeds up transportation and prevents the upper portion of the building getting more service than the lower when there is a heavy peak of down traffic. When there is heavy down traffic, if the elevators run local only they may be filled with passengers entering on the upper floors, and the passengers on the lower floors may have to wait for several full elevators to pass before they can be accommodated. The express and local service also considerably increases the traffic-handling capacity per elevator over what it would be with all local service.

The division of the two groups of elevators in this building is made at the 19th floor, which is a little less than half way up. This is the correct division to give sufficient handling capacity for the number of guest rooms served by each group. Six elevators in each group give 5-min. handling capacity as indicated by tests of other hotels based on normal busy registration, and average time between elevators leaving the terminals is good.

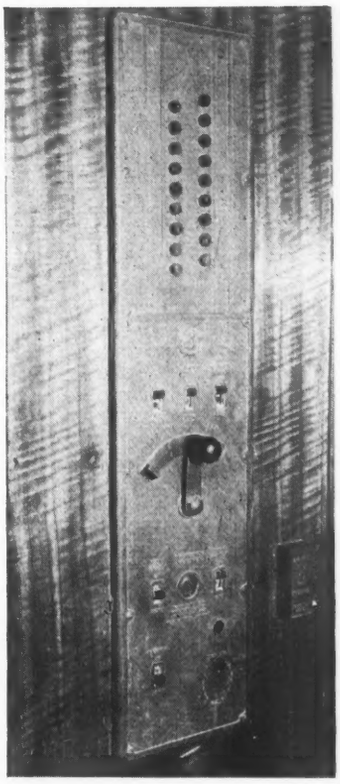
Elevator Arrangement Around the Lobby

The elevators are arranged around a lobby adjoining the back of the main hotel lobby. There are five elevators on each side of the elevator lobby and two across the back. The space for the waiting passengers is 18 ft. wide x 37 ft. long. This is an excellent location, close to the center of the building and convenient to all the public rooms.

Elevators of 3,000-lb. capacity have been found to be most suitable for hotel service. Smaller cars are objectionable, not only because hand baggage is sometimes carried, but also because parties that want to travel together in the elevators are frequently separated when smaller cars are used. In general, also, the larger cars tend to prevent crowding and add to the comfort of the guests.

The speed of all the main passenger elevators is 700 ft. per minute. Being automatic in operation, these elevators accelerate, run and retard smoothly, so that the guests will have no unpleasant sensations due to elevator movement. They are provided with metal doors, not only for the hatchway openings, but also for each cab. As the cab doors are closed while the car is moving, the passengers do not notice the speed at which the elevator is operating.

Passengers coming to the elevators press the button for an up or a down car and the first car that can accommodate them is automatically stopped and leveled at the landing, the doors unlocked and opened automatically. After the passengers have entered the car, which is maintained level with the landing, they call the floors at which they desire to alight and the operator presses the corresponding buttons directly over the operating lever, one button being provided for each floor. After the passenger transfer at the landing has been completed the operator throws the lever and the doors close automatically, and when they are closed and locked the car starts and makes the run to the next landing for which a stop is set, either by car or hall buttons. As the car slows down to stop at the landing the lantern in the hall over the corresponding hoistway door is illuminated for up or down, depending on which way the car is traveling.



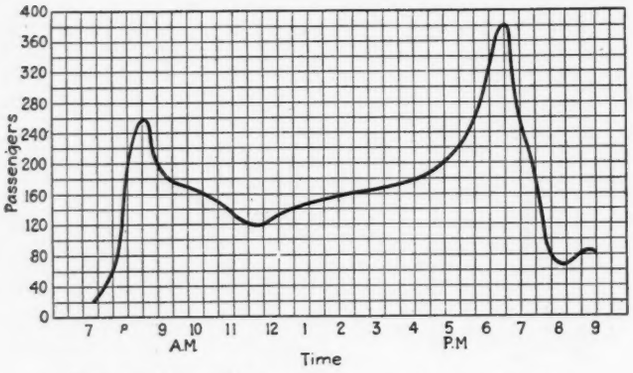
Operator's car-control panel

When a hall lantern is illuminated it is certain that the corresponding car will stop at the landing. When the car is close to the landing it is under the leveling control, which has a definitely limited slow speed that always moves the car toward the landing. The operation of this leveling control is limited to a zone extending a short distance on each side of the landing. The doors open automatically, so that when they are sufficiently open for passengers to enter or leave, the car is level with the landing.

The cars generally make complete trips between the terminals, stopping at all floors for which landing or car buttons have been pressed. The control is so arranged that the elevators may be reversed at any point in their travel. The doors may also be reversed at any point in their travel. This is principally to allow the operator to check the doors when they are closing, in case of unexpected sudden entrance or exit of a passenger. A separate control is provided for operating the car at leveling speed if that should prove desirable at any time. An emergency switch allows cutting the power and applying the brakes in case of emergency.

A spring-centered switch allows the operator to pass the landing stops by holding the switch in. As soon as this switch is released the elevator again resumes the landing stops. Landing stops always remain active until a car has stopped to

A bank of elevator-machine controllers on the local passenger elevators



Curve of expected passenger elevator traffic in the New Yorker

The elevators have a traffic-handling capacity based on the maximum number of people coming to them in any 5-min. period. The maximum peak is always in the evening about 6 o'clock, which in many cases is the checking-out hour.

take off the waiting passengers. This device allows full cars to pass landing stops without being delayed, but the waiting passenger is assured that the first elevator that has accommodation will stop.

Normally all hoistway doors must be closed and locked while the car is in motion, except for a zone extending a few inches on either side of the landing, in which the doors are permitted to operate while the car is leveling. The car doors are provided with contacts that require them to be closed before the elevator can start and remain so until the car has reached the leveling zone. A glass-covered switch permits the car, after the glass has been broken, to be operated in emergency without restriction by the interlocks.

Motor-Generator Sets

Voltage control for these elevators is furnished by individual motor-generator sets. These consist of a compound direct-current motor running at about 1,200 r.p.m. that drives a direct-current generator having a variable field. The armature of this generator is connected directly to the armature of the elevator motor. As the generator's voltage is increased the elevator is accelerated, and as the voltage is decreased it is retarded. The acceleration and retardation are always smooth, because the induction of the generator field prevents a sufficiently rapid change of voltage to cause uncomfortable operation of the elevator. The motor-generator sets have remote control and are started and stopped by a key switch in the car-operating panel. It is necessary to insert the key and then operate the switch, to start the motor-generator set. Indication that the set is running is shown by the illumination of a red jewel adjacent to the switch. In case the power should fail or the motor-generator set stop for any reason, it is necessary to reoperate the key switch in order to start the set again.

The elevators are of the gearless traction-type, the driving motor operating at about 75 r.p.m. The traction drive is of the double-wrap type, with 6 hoisting cables passing from the car over the traction sheave around an idler sheave, back over the traction sheave and thence directly to the counterweight. The weight of the ropes is compensated by cables running from the bottom of the car around a sheave atttached to a tension device in the pit and thence to the counterweight.

Two electric automatic devices slow down and stop the elevators at the terminals. In case an elevator should overtravel, the traction is relieved and the driving sheave can rotate without moving the car, so that there is no danger of car or counterweight coming into contact with the overhead structure. The cars are provided with mechanical safeties operated by governors. If the elevator exceeds the proper speed, the governor automatically cuts off the power and applies the brakes. If this is not sufficient to slow down the car, the governors apply the mechanical safety attached to the bottom of the car sling. When this mechanical safety acts it must be released manually before the elevator can be operated again.

Oil buffers are provided for the car and counterweight. Should the elevator approach the limits of travel without slowing down, the buffers will stop the car or counterweight without excessive retardation.

Cabs of special design are used on the main passenger elevators. There are two beautiful patterns employing English gray hairwood with ebony inlays and oriental walnut. The grilles and railings are of solid bronze.

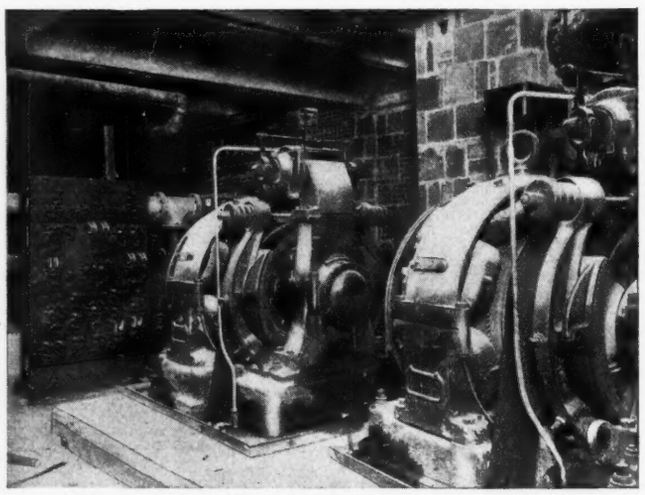
The automatic control of stops and leveling is by means of a selector driven by the car through the medium of a steel tape. This device, in conjunction with the landing and car buttons, the elevator magnet controller and landing-stop relays, automatically controls the slowing down, stopping and leveling of the elevators in response to the momentary pressure of the push buttons.

Elevator Controllers

The elevator controllers consist of magnet-operated switches, which handle only auxiliary and field currents. There are no contacts handling heavy currents, and consequently the deterioration of contacts is small and the maintenance low. The timing of acceleration and retardation is by choke coils and does not depend on any mechanical timing device. All the controlling apparatus is located in the penthouse, with the exception of the operating panel in the car, which carries only small currents, and the push buttons and lanterns in the halls.

The starters are provided with dispatching and scheduling apparatus showing the position of the cars at all times and the floors on which passengers are waiting. There is telephone connection between the cars and starters, and also with the chief engineer's office.

There is a large ballroom elevator of 5,000 lb. capacity,



The elevator machines are of the double-wrap gearless traction type

There are 12 passenger and 6 service elevators of the gearless-traction type. These operate at 700 ft. per minute and have multi-voltage control with automatic leveling at the landings. Six of the passenger elevators operate local to the 19th floor only and six operate express to the 19th floor and local to all floors above. The service elevators run to all floors.

operating at 250 ft. per minute, serving the first to third floors, inclusive. Operating between the street floor and ballroom floor, this elevator will be able to handle 125 persons in 5 min. with one-way traffic, and 150 persons in 5 min. with the traffic both ways. It should be able to accommodate the traffic between the lobby floor and the ballroom, requiring little if any help from the main passenger elevators. The banquet hall will also be served by this elevator, and as it is only a short distance above the main lobby floor it is probable that the stairways will be used for most of its traffic.

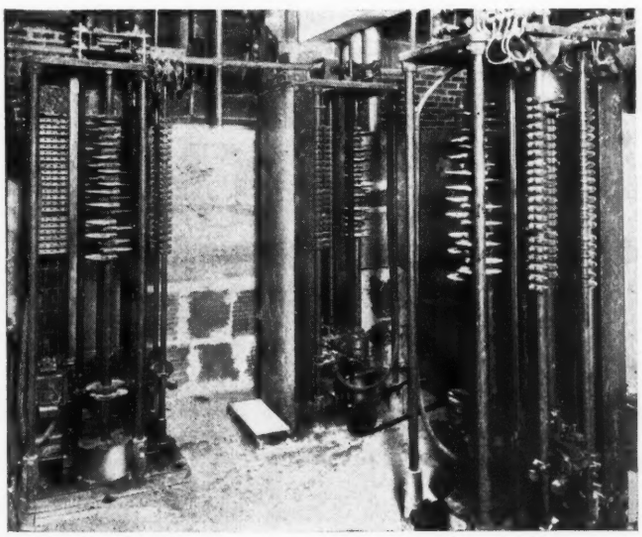
A 5,000-lb., 100-ft. per minute elevator serves from the second basement to the first floor. This elevator will take care of the traffic between the subway station and the hotel.

The service elevators of the hotel are arranged in the most practicable manner in a private service hall adjacent to the main passenger elevators. Six cars are provided, three running from the basement to the roof, stopping at 44 landings, and three from the basement to the 39th floor stopping at 42 landings. These elevators are 3,000-lb. capacity and have a speed of 700 ft. per minute. The control is of the unit-voltage type, and automatic leveling is provided. This is particularly advantageous for handling trucks. The service elevators are manually operated and have flashlight annunciators with automatic reset in all the cars. The number, capacity and speed of the elevators is based on the expected service requirements of this hotel.

There are two freight elevators of 4,000-lb. capacity at 200 ft. per minute speed, running between the fourth basement and the third floor and serving all intermediate floors. These elevators have flashlight annunciators and mechanical dial indicators.

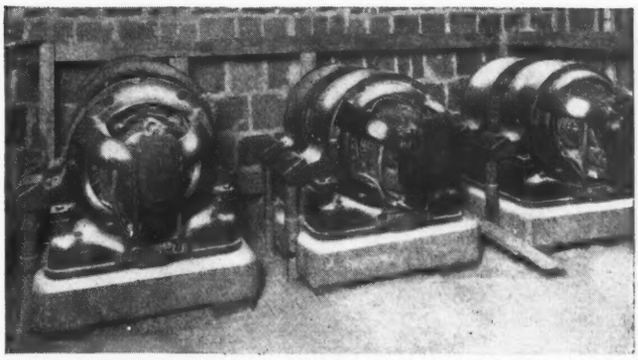
Four electric dumbwaiters operate by push-button control, between the kitchen and the tearoom. These have a capacity of 300 lb. at 100 ft. per minute and 500 lb. at 80 ft. per minute.

There is a bank in this building that is provided with a passenger elevator of 2,000-lb. capacity, having a speed of 200 ft. per minute, and also a dumbwaiter of 200-lb.



Selectors stop the cars automatically at the floor landings

The automatic control of stops and leveling is by a selector driven by the car through a steel tape. This device, in conjunction with landing and car buttons, the elevator magnet controller and landing stop relays, automatically controls the slow down, stopping and leveling of the elevator at the landings in response to the cells made by the car and landing buttons.



Each elevator machine is supplied with power by a motor-generator set

capacity at 100 ft. per minute. These machines will operate between the first basement and second floor and serve the bank only.

All the elevators have the most modern and improved safety devices. Every possible safeguard is provided to prevent even minor accidents, and the system used demands that all safety devices must be in working order at all times if the elevator is in operation. Particular attention has been given to safeguarding the transfer of passengers at the landings. The tripping hazard is eliminated by the automatic leveling, and the interlocks and other devices virtually obviate other accidents at the landings.

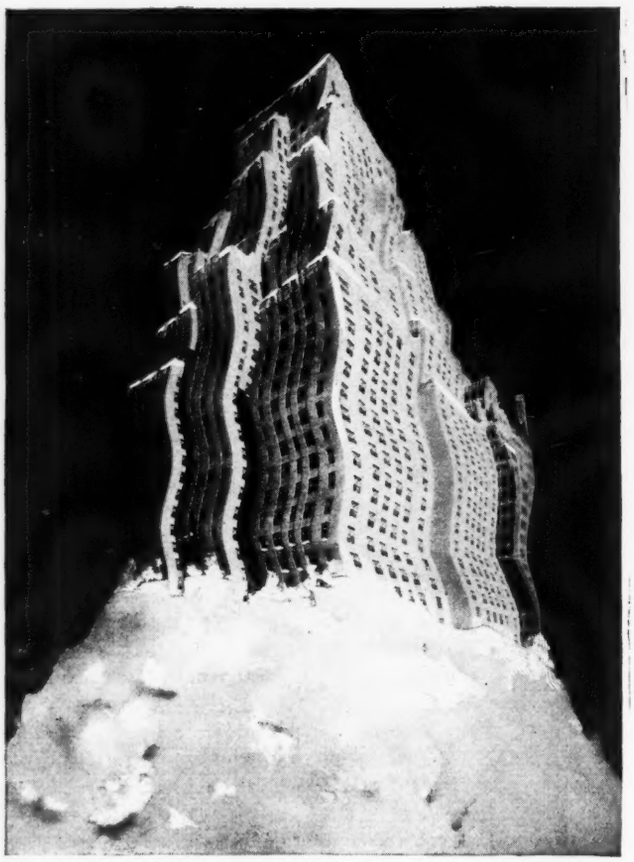
The doors on the passenger elevators are opened electrically, by a single motor and engine located on the car, and are closed by spring action, which insures safety. Separate oil checks cushion the opening and closing of each set of doors. The tracks, hangers and operating

ELEVATORS AND DUMBWAITERS

Service	Number	Speed, F.P.M.	Capacity, Lb
Passenger, express	6	700	3,000
Passenger, local	6	700	3,000
Service	6	700	3,000
Ballroom	1	250	5,000
Subway	1	100	5,000
Bank	1	200	2,000
Freight	2	200	4,000
Hotel dumbwaiters	4	100 80	300 500
Bank dumbwaiter	1	100	200

mechanism are of the latest design and insure smooth, quiet and safe operation.

The elevators and their arrangement in the New Yorker are excellent in every respect. They are the result of the best engineering and artistic skill and have not been unduly restricted by consideration of cost. The automatic signal control elevator has been proved by several years' operation in the large modern hotels to be highly satisfactory for this class of service. This control is now standard for all large high buildings. Perhaps the main advantage is that it eliminates the human element, in the actual handling of the elevator. This is more important than is generally appreciated. Courtesy to the passengers should be one of the chief qualifications of elevator operators. If the operators have to take the responsibility of operating the car and also be subjected to the physical effort of handling the car and landing doors, they are not always going to be in a courteous state of mind. Making the elevators' operation automatic, not only relieves the operators of the physical and mental strain associated with manually controlled machines, but leaves them free to give their entire attention to serving the needs of the passengers.



COLD FROM CO_2 IS SAFE -- ECONOMICAL

THERE IS AN INTENSE OBJECTION *to refrigeration media possessing penetrating odors. For this as well as other reasons, public buildings, theaters, office buildings and hotels are inclined to favor the use of odorless and inert refrigerants. The New Yorker took cognizance of the popular attitude and installed carbon-dioxide refrigerating machinery.*

THE services requiring refrigeration include the drinking water system, the ice-making tanks, the ice-cream manufacturing process and the food-storage rooms of the kitchen. In addition, the air conditioning entails the use of a refrigerating system to cool the air. All of this equipment is installed in the fourth sub-basement.

For the sharp freezer and ice-cream hardening rooms a brine system has been installed to operate at —10 deg. F. The brine is pumped through a double-pipe cooler by one of two motor-driven centrifugal pumps of 75 gal. per minute capacity each; these appear in Fig. 1. Carbon dioxide is circulated between the inner and outer pipes of this cooler, and as the cooler sets in the brine tank, the CO_2 absorbs heat both from the brine inside the cooler and from the brine in the tank. The warm brine from the freezers returns to the brine tank. The 15-ton compressor, with a $3\frac{7}{8}$-in. bore and $12\frac{1}{2}$-in. stroke, which handles this load, will operate with a suction pressure of approximately 255 lb. gage, giving a vapor suction temperature of around —12 deg. F.

To supply ice for the dining rooms and other demands, a steel ice-freezing tank has been installed. This tank is insulated on all sides and on the bottom with 6 in. of cork. The freezing is carried on in 132 300-lb. cans placed in eighteen rows in the tank brine, with $1\frac{1}{4}$-in. CO_2 evaporating coils placed between each pair of rows, making a total of 12,000 lineal feet of cooling surface.

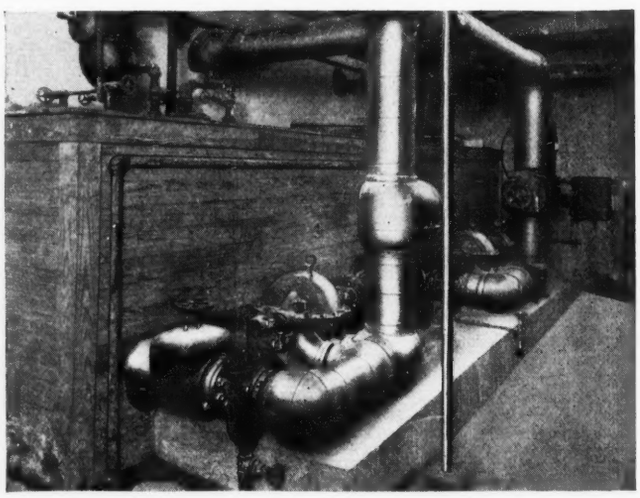
A low-pressure raw-water agitation system with removable air tubes will be used to obtain clear ice, and cores will be sucked by a $\frac{3}{4}$-in. rotary pump.

Brine from the tank at from 5 to 10 deg. F. is taken by one of two 200-gal. per minute motor-driven centrifugal pumps located at one end of the ice tank and at a level that permits gravity-flow suction. This brine is circulated through the kitchen boxes and through the shell-and-tube drinking water coolers.

To handle the carbon dioxide in this system two 120-ton $6\frac{7}{8}$x24-in. single-cylinder horizontal compressors are provided. One of these is driven by an 185-hp. variable-speed motor, while the other is direct connected to a 200-hp. horizontal uniflow steam engine having a special wide-range governor.

The camshaft of the engine is driven from the crankshaft by a set of right-angle helical gears, and a coupling is inserted in this shaft to facilitate its removal and for

Fig. 1—The low temperature brine pumps and brine cooler



timing purposes. It is the outer shaft shown on the engine in Fig. 2. It carries the lifting cams of the inlet valve gear and all of the cams for the exhaust valve gear. As it is geared directly to the main shaft, the lead on the inlet valve, as well as the timing of the exhaust valve, is constant. This shaft also drives the governor through a set of spiral bevel gears with a three-to-one speed ratio, that is, the governor runs at three times the engine speed.

The other shaft, which runs parallel to the main camshaft, is driven through a set of spiral helical gears, the long-face gear being fixed on the inner shaft, and the shoft-face gear being connected to the governor movement by a sleeve-and-bell crank lever. This gear is splined on the main camshaft. The governor movement, therefore, advances or retards the inner shaft, which advances or retards the cutoff, since the cams which seat the steam valve are on this shaft. The movement of the governor in no way affects the outer, or main, camshaft.

The hand wheel on the side of the governor increases or decreases the spring tension, depending on which way it is turned, increasing or decreasing the balanced speed of the governor, and hence the speed of the engine. This permits a speed reduction of two to one, and gives a close regulation at top speeds and a fairly good regulation at the lower speeds.

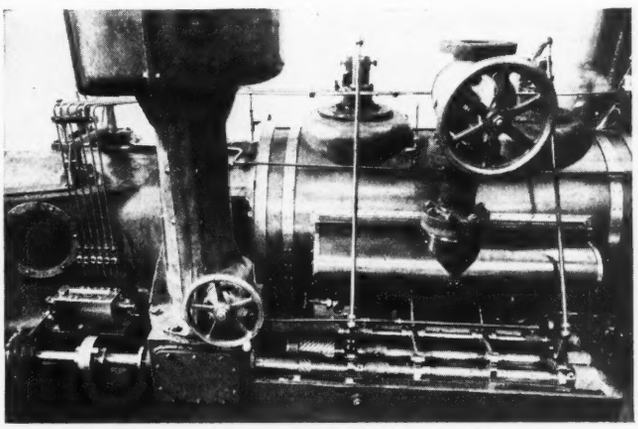


Fig. 2—Valve gearing of the uniflow engine driving one of the compressors

The cranks on the compressor and engine are set at approximately 90 deg., in order that the maximum torque resistance from the compressor comes simultaneously with the maximum torque exerted by the engine, and the minimum torque required by the compressor comes simultaneously with the minimum torque produced by the engine.

The brine from the ice tank is pumped through two shell-and-tube coolers, where it cools the drinking water used in the hotel. One of the tanks supplies the requirements up to the 21st floor, while the second tank is for the water used above this floor. The pumping is done by two 35-gal. per minute centrifugals direct connected to 5-hp. motors.

Condensation of the CO_2 gas delivered by the compressors is carried out in two 10-stand sets of double-pipe condensers, each stand having 8 coils 20 ft. long.

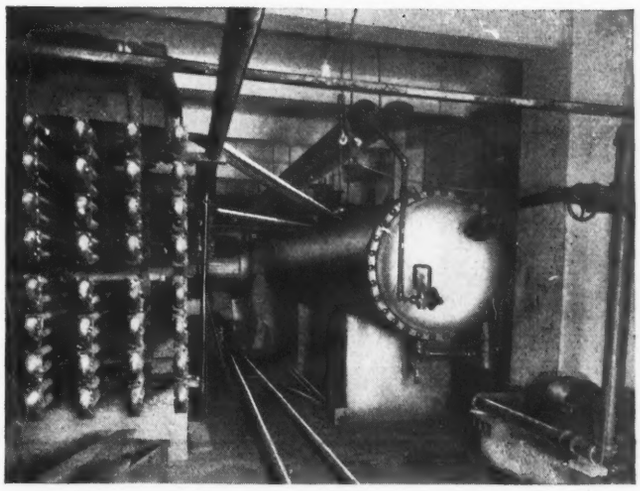


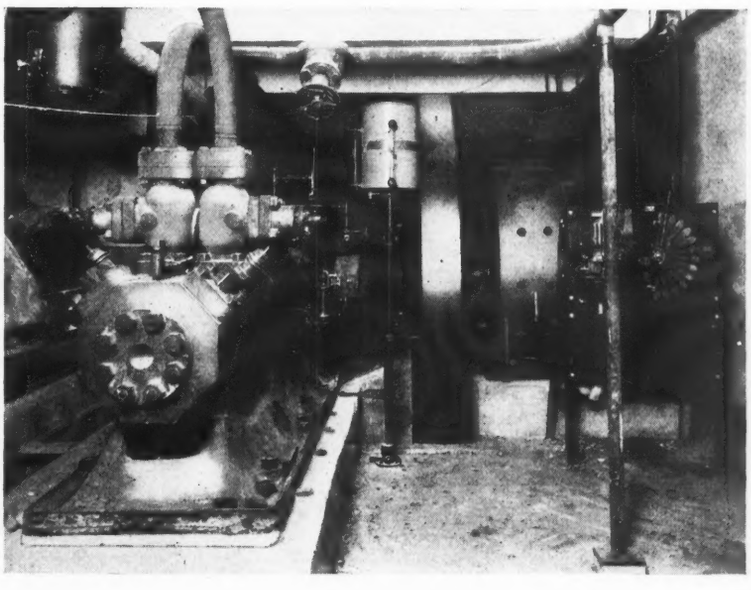
Fig. 3—A shell-and-tube drinking water cooler and one of the condensers

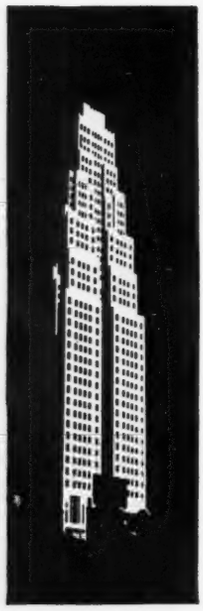
In the air-conditioning system a duplex 5x16-in. CO_2 compressor direct-connected to a 150-r.p.m. variable-speed motor has been installed. This has a capacity of 167 tons at 200 r.p.m. The suction will be carried at 480 lb. The discharge gas goes to one of the double-pipe condensers already mentioned and after condensation the liquid CO_2 is led to two sets of snake-type direct-expansion coils placed in the air-conditioning water tank. The water from the air conditioner flows into galvanized troughs, out of which it trickles down over the coils.

All the CO_2 piping has welded joints. There are no packed joints except at the stems of the control valves. To prevent vibration, no pipe hangers are used, all the lines being supported by pipe columns which have a cork cushion at their bases.

The ice tank will be handled by the man attending the various details of refrigerating plant operation. In addition an engineer will have direct charge of the compressors and other machinery. The engine-driven compressor will be operated during the summer months, as its steam rate is better than that of the generating units when the electrical losses are taken into consideration.

Fig. 4—One of the motor-driven CO_2 compressors





DUST WATER MESSAGES

-- POWER SERVICE PROBLEMS

Engineers of building and industrial power plants have many services to superintend other than heating, ventilating, and power generation. In this respect hotels go further than any other type of installation. This article will touch upon some of the many power services in the New Yorker that have not been previously described in this number.

THE supply of water to meet the many hotel needs is of utmost importance, and, therefore, connections have been made to the city mains on Eighth Ave., 35th and 34th Sts. After the water has been metered, the main divides, branches delivering water to those uses that can be supplied with city pressure, and others delivering water through float valves to an 80,000-gal. storage tank located in the fourth cellar. This tank supplies the pumps that deliver water for all uses not supplied at city pressure.

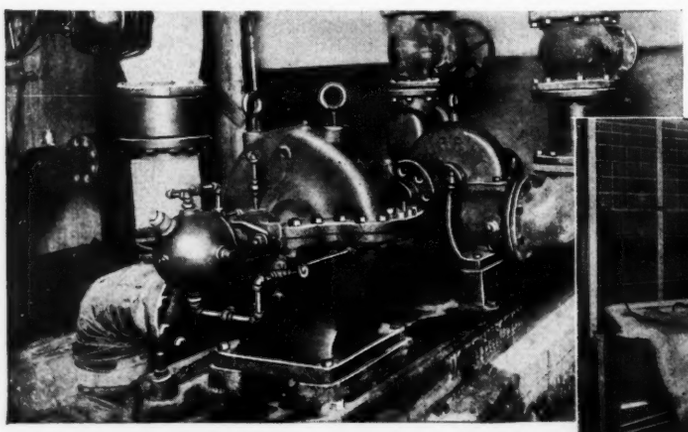
There are four house-service pumps, one of which is a spare, that deliver cold water to high-rise, intermediate-rise, and low-rise tanks. These pumps are all operated under float control, and high- and low-water alarms are provided for each tank.

The high-rise tank is located on the 42nd floor and is served by a 300-gal. 500-ft. centrifugal pump. The intermediate-rise tank is located on the 34th floor, and is served by a 600-gal. 200-ft. pump, and the low-rise tank on the 24th floor is served by a 1,000-gallon 300-ft. pump. The spare pump is turbine driven, but the other pumps are all driven by direct-current motors.

All of the cold water required by the guest and service rooms above the fourth floor is furnished by these tanks direct. They also supply water to the hot-water heaters that serve the upper floors.

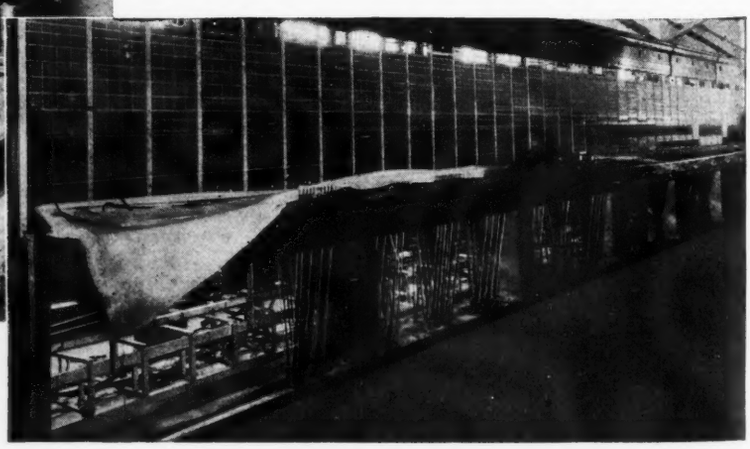
In all, there are a total of ten heaters located in the fourth basement cellar. They are all 42 in. in diameter, 13 ft. long, and equipped with thermostats that control the supply of 3-lb. exhaust steam. The high-rise and intermediate-rise tanks each serve one heater, and a spare has been installed that can be served by either of these tanks. These three heaters are capable of heating 6,000 gal. of water per hour.

All of the other heaters are of 12,000 gal. per hour capacity. Two of them are supplied with water from the low-rise tank, and the remaining heaters receive water direct from the city water header. Two heaters furnish hot water to the laundries, two to the kitchen



Above—One of the house service pumps

Below—The 24-position telephone exchange necessary to handle the expected traffic



and pantries, and one is used for general hot-water service in the lower floors and cellars. As indicated in previous articles, the supply of hot water at city pressure is supplemented by water from the hot-well tank and from the boiler blowoff tank.

In addition to cold- and hot-water services, all of the guest rooms are supplied with ice water. There are two ice water systems one supplying the requirements up to the 21st floor and the other serving the remaining floors. Two 35-gal. pumps circulate the ice water through these closed systems.

Cleanliness must be one of the watch-words of hotel operation. To assist in this, a centralized vacuum cleaning system has been installed to serve the first four floors. This system consists of two 42-in. turbo fans connected to a 50-in. separator. An 8-in. header from the separator leads to 42 outlets located so that 50 ft. of hose will reach all parts. Each unit has capacity to operate eight sweepers at one time. Vacuum cleaning on the other floors will be taken care of by individual portable outfits.

The problem of communication in the hotel has been divided into two parts—that affecting the guests, for which telephones have been installed in all rooms, and that affecting the operation of the hotel. The installation of the telephones in this hotel has proved to be no small undertaking, requiring one of the largest private telephone exchanges. The exchange is located on the 39th floor, making it the highest exchange in the world, and consists of a 24-position board.

Interdepartmental communication has been provided for in several ways. A pneumatic tube system permits the sending of messages to 60 different stations throughout the building. These stations include the room clerks on each floor, the general offices on the first and fourth floors and such departmental heads as the chief engineer, housekeepers, stewards, chefs, timekeepers, laundry, etc. The distributing center of this system is located on the lobby floor. The fan equipment has been installed in the third cellar, and consists of two 63-in. diameter turbo blowers. Each has a capacity of 5,400 c.f.m. at a suction pressure of 1 lb., and is direct-connected to a 40-hp. 1,750-r.p.m. motor. The system has required the installation of 27,000 ft. of 3-in. brass tubing.

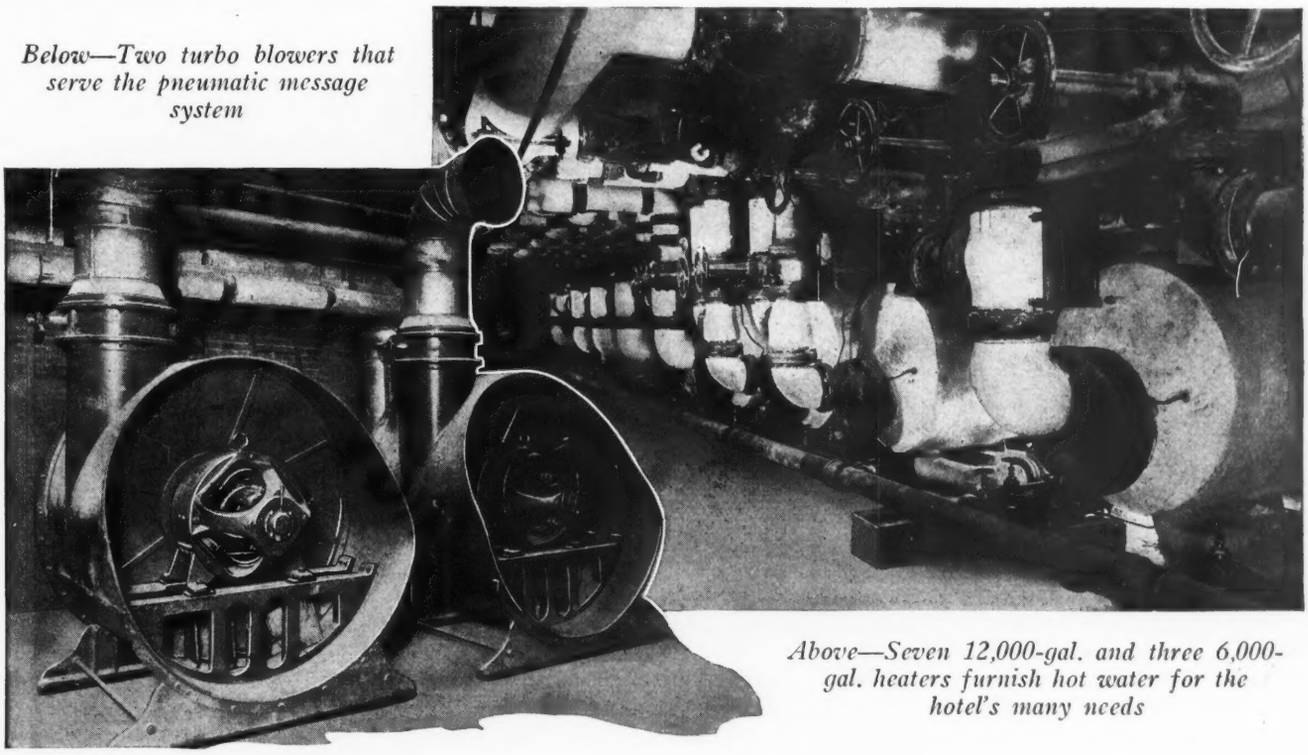
An additional channel for communication has been provided for by the installation of a telautograph system. These instruments have been furnished to the room clerks on all floors, as well as to the offices in the lobby and on the fourth floor.

To provide for entertainment of guests, an extensive radio system has been installed. Every guest room has been equipped with a 15-in. cone loud speaker, and radio receiving equipment has been installed that will permit the guests to select any of four programs. A public address system has been placed in the banquet hall, main dining room, tea room and ball room. Such programs as may be given in these rooms can be made available to the guests' loud speaker system, and can also be broadcast through a leased telephone wire.

Fire protection has been provided in several ways. Hose outlets and fire alarm boxes have been installed on all floors. The alarm boxes connect to a panel, in the chief engineer's office, which indicates from where an alarm has been sent. Also the alarm is sent through the American District Telegraph system to the city fire department. A watchman signal system is also installed.

A sprinkler system has been installed to serve such work spaces as kitchen, pantries, laundries, valet service and offices. The sprinkler system and hose outlets are supplied with water from the various house tanks. However, as the demand caused by a fire would quickly use up the stored water, a steam-driven fire pump of 1,000 g.p.m. capacity has been provided, which supplies the hose and sprinkler system direct.

Below—Two turbo blowers that serve the pneumatic message system



Above—Seven 12,000-gal. and three 6,000-gal. heaters furnish hot water for the hotel's many needs

METERS

GUARD SERVICE A

INSTRUMENTS AND METERS *have become a recognized necessity in the operation of large buildings, just as they are in large industrial power plants and central stations. In the New Yorker Hotel, an extensive meter equipment will give a record of the coal and water going to each boiler, the steam produced and the distribution of steam, water and power to the different services.*

METERS have been characterized as valuable watchdogs always on the alert for conditions that cause power losses and expensive shutdowns. The operation of a large modern hotel like the New Yorker involves large expenditures for mechanical and electrical services. If these are to be made intelligently, it is necessary to know what they are made for.

If the latter is done, an intelligent check can be made on the expenses month by month and year by year. In the actual operation of the plant a check may be made of the daily shifts. Then, if a defect is developing in a piece of apparatus, or the operators are becoming lax in handling equipment, such conditions are discovered before they have had time to cause failures or losses in fuel and power.

Metering the coal and the water to each boiler and the steam produced gives information to check the operation of individual boilers and also shows the skill of the operators. In addition, records of pressure, draft, CO_2 and temperature give the executive engineer each day a complete picture of the plant performance on the previous day. Any variation from good practice is easily detected and corrected, and the responsibility for faulty operation is placed where it belongs.

Changes in power consumption above normal are a warning that something is going wrong in the equipment and should be investigated. Many cases are on record where meter readings have shown trouble on the inside of machines, when everything looked fine from the outside. Daily meter reading of power consumption will also show if machines are left in service when they should be shut down.

Meters and the proper use of their records are indispensable if reliable and efficient operation is to be maintained. With this in mind, a large number of meters have been provided in the Hotel New Yorker. The coal as it comes from the bunker is weighed automatically to each pulverizer. The total feed water to the boilers is measured by a recording and integrating Venturi meter, and the steam supplied by each boiler is indicated and recorded by steam-flow meters. These meters, along with the CO_2 recorders, draft gages and other instruments, present to the operating engineers a continuous picture of the boilers' operation. Any variation from normal can be immediately detected and rectified. Meter readings promote competition between the different shifts, and as the operators know exactly what they are accomplishing, they are encouraged to have a keener interest in their work.

By measuring both the feed water and the steam and taking account of the blowdown losses and the steam used in the soot blowers, a fairly reliable check can be kept on the accuracy of the meters. Both superheated and saturated steam are supplied by the boilers. There is a flow meter on each of the steam outlets. Meters record both steam flow and temperature on the superheated-steam outlets. The latter give the performance of the superheater. These meters also measure the steam taken by the engines in the power plant, as no other steam is taken from this line.

Condensate meters are connected into the discharge of the pumps on the returns from the heating system and the hot-water heaters. They provide a record for allocating the cost of these services. In the winter time, when there may not be sufficient exhaust steam to take care of all heating needs, steam from the saturated header will be supplied through reducing valves to the heating system. The quantity can be determined by taking the difference between the meter readings on the superheated steam lines and the readings of the condensate meters.

CE AND PROFITS

Thus it will be possible to charge each service with its proper amount of steam.

Flow meters are also provided to measure the quantitives of steam used by the laundry, kitchen, barber shop and other departments using live steam. These meters are equipped to record the pressure of the steam supplied, so that not only the quantity of steam used will be known, but also its pressure. The latter will be valuable in checking up on the action of reducing valves, and in case of complaint regarding the pressure of the steam to any of these services. A recording pressure gage on the engine exhaust header and a recording thermometer will show the conditions under which the engines are exhausting.

The total water to the building is metered as it comes from the city mains. On these lines there are also recording pressure gages. Their readings will be valuable in checking the pressure maintained in the lines supplying water to the building. If the water supply fails, the pressure records will show the location of the fault. Water meters have been provided on the principal services, such as the laundry, kitchen, barber shop, Diesel engine, etc., so that each may be charged with what it uses.

On the switchboard there is the usual complement of voltmeters, ammeters and wattmeters to show the operation of the generators. There are three ammeters on each generator, one in each outside leg and one on the neutral. These will show how nearly the load is balanced on the three-wire generators, and the neutral ammeter readings will also act as a check on the accuracy of the meters in the outside legs of the circuits. There are two voltmeters, one having a switch by which it may be connected to the outside legs of any one of the generators. The other voltmeter has a switch to connect it to any two of the three legs of the system and between the outside legs and ground.

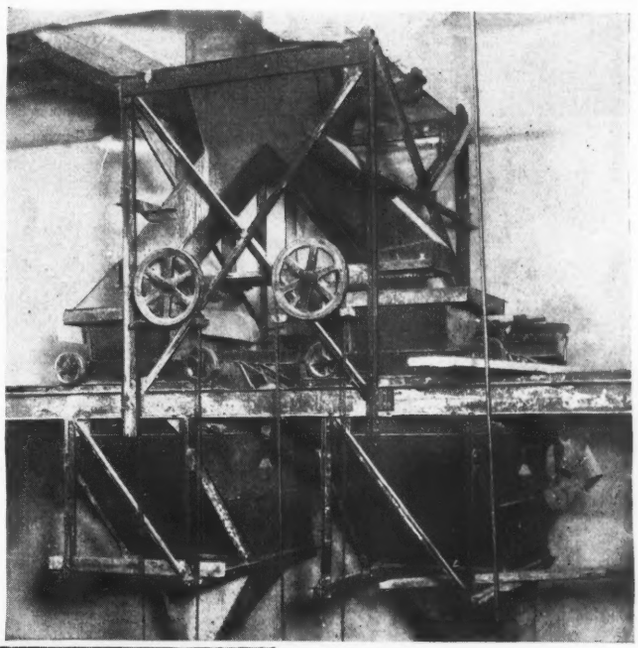
A recording and indicating wattmeter with two pens will record and indicate the power in each side of the system and will show how much the system is out of balance. These records are not only valuable in the normal operation of the generators, but also when abnormal conditions develop. Two master watt-hour meters, one for the lighting load and the other for power, record the quantities going to each service. The power required for each will be determined by watt-hour meters located on the back of the switchboard.

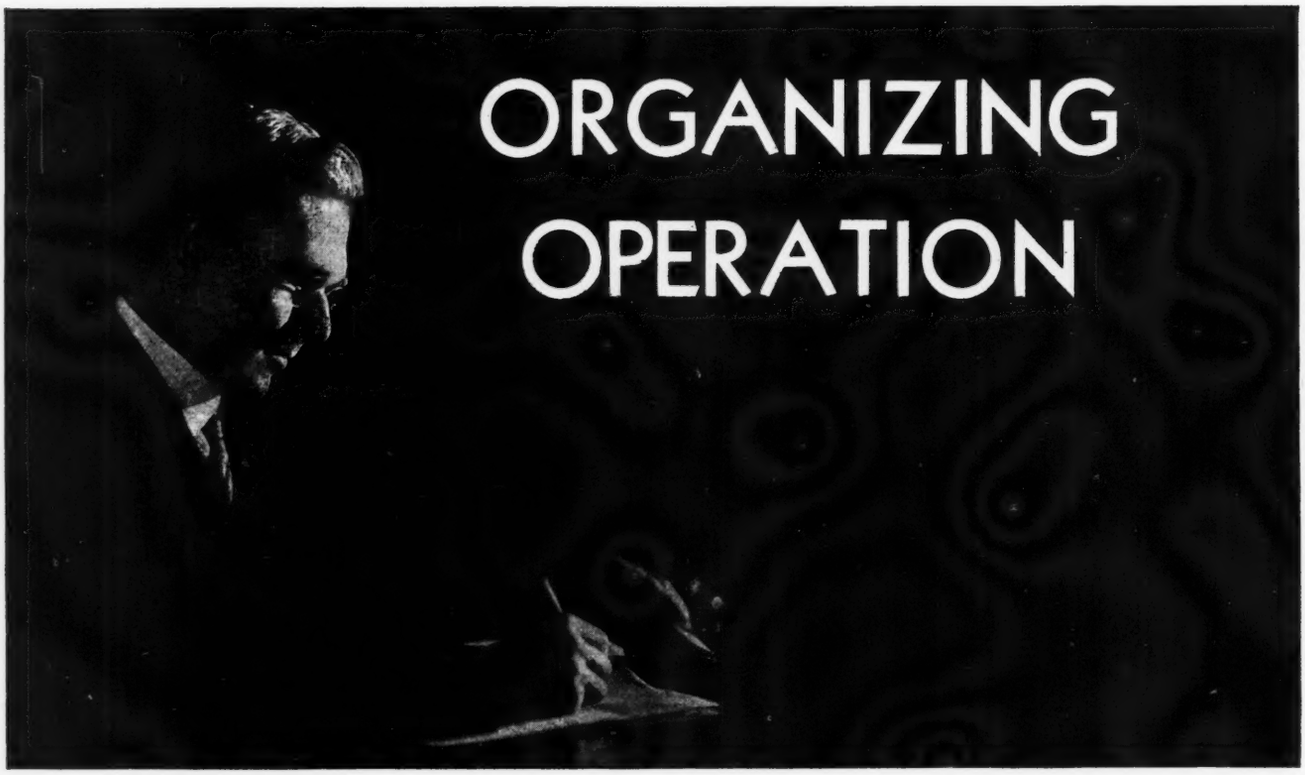
There are watt-hour meters on the power feeders running to the elevators, refrigeration equipment, house pumps, boiler-feed pumps, coal pulverizers and other equipment. The reading of these meters, in addition to showing the power consumed by the various services, will act as a check on the condition of the apparatus.

There are many other meters, thermometers, gages, etc., for measuring quantities, temperature, pressure, humidity and other values in the regular operation of the power plant and other services. The foregoing, however, are sufficient to indicate that the designer and those who will operate the plant appreciate the economic value of comprehensive records in plant operation and have provided the means for obtaining them.

Right—Weightometers on the coal chutes

Below—Meter section of main switchboard





ORGANIZING OPERATION

By WARREN D. LEWIS
Chief Engineer,
New Yorker Hotel

THE ORGANIZATION OF OPERATION *starts with the designer. Without his active co-operation in providing suitable units—properly related, metered, controlled and safeguarded—good operation is impossible. The job of the engineer in charge of operation is to marshal men and the available equipment to deliver the most perfect service possible at the lowest cost.*

IT WOULD be far easier to write on the operation of the New Yorker after the plant had been running for six months or more. Under the circumstances it will be necessary to give some facts as they are at present and others as we expect they will be in the future, when everything is "warmed up and broken in." Several unusual features in the design and construction of the New Yorker power plant (using the term to include all mechanical and electrical equipment) render the organizing of the engineering operation somewhat different from that in hotels in the past. The other articles in this number deal with most of these features in detail, so that they need not be touched upon here beyond explaining their relation to the operating problem.

It may not be out of place to stress the importance of the power services in a modern hotel, especially where there is no emergency supply of either steam or electricity from an outside source, as in this case. This in itself places an additional responsibility upon the operating force, although the designers have kept always in mind the fact that the plant must stand on its own feet. The entire plant has been designed and built with the following objectives: (*a*) reliability, (*b*) economy of operation, (*c*) simplicity both in operation and in maintenance. These three fundamentals are so closely related in the design of the plant that it is difficult to discuss one without mentioning the others.

Reliability and economy of operation have been provided for in the general layout by confining the entire plant to the fourth cellar and installing modern high-class equipment. Numerous gages and meters make possible intelligent operation. Incidentally, the various apparatus installed is such that it is easily maintained.

Features that have particularly influenced the organization of the personnel of the engineering department, as well as the operating schedules, may be listed as follows:

1. The Diesel engine-generator set, which takes the place of the usual central station electric breakdown service.
2. The pulverized-coal installation in the boiler room.
3. The fly-ash collector on the roof of the hotel, which is an unusual application of this type of apparatus.
4. The ventilating and air-conditioning systems.
5. The elevator system, with its high-speed electric passenger elevators, signal-controlled, representing the most modern practice in vertical transportation.
6. The general design and construction of the hotel, which is a silent demand of the management that *service* must be the keynote of operation.

These are some of the major items that influenced the operating methods and schedules; others of less importance will be mentioned later.

Maintenance of service throughout the hotel, both day and night, is our primary problem, and it may be divided into two parts. First comes the regular operation and maintenance of the power services. The second division includes the special (complaint) maintenance and repairs of the building and equipment, more especially where it affects the guests.

Maintenance and repair service are more uncertain quantities than the regular operation of the building and plant, but must nevertheless receive equally prompt attention. To assist in this work each floor clerk's station is equipped with telephone, telautograph and pneumatic tube service. Similar services are provided for the clerks in the lobby, the engineer's record office, telephone switchboard room and at other advantageous points.

The passenger and service elevators are equipped with a private intercommunicating telephone system, with an instrument in each elevator, penthouse and engineer's record office. All of these are controlled through the elevator starter. With this equipment it is possible to get help in an emergency by using the telephone or by sending a written order for repairs through the pneumatic tubes.

To simplify keeping track of repairs and maintenance, those authorized to issue repair orders are supplied with books of order blanks, which are filled in, signed and sent to the engineer's record office through the pneumatic tubes. Written orders are issued in this way by the floor clerks, as well as by the laundry, kitchen, housekeepers and other departments. Orders are recorded as received by a clerk in the engineer's record office, and mechanics are dispatched to make the necessary repairs as promptly as possible.

To keep the cost of operation and maintenance of both the power plant and building at a minimum, the management has installed a modern private generating plant, well metered and charted, and amply provided with all necessary electrical and mechanical equipment.

In the boiler room this is well worked out. Coal is delivered to the building by truck and dumped through a sidewalk coal hole into the crusher, passing over a magnetic separator on the way. It is then distributed to the coal bunkers by a belt conveyor, from which it is fed through individual coal scales to the unit pulverizers and thence to the boilers.

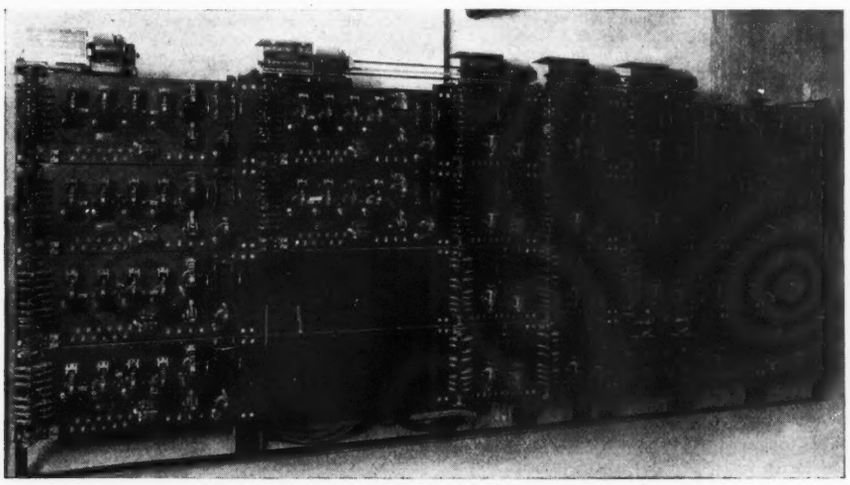
Ashes when removed from the boilers are conveyed by a vacuum ash system to a large storage tank above the driveway (at the street level) to be dumped into ash carts for removal from the building. A dust collector for the fly ash in the flue gases, as mentioned previously, is located on the roof and automatically collects and conveys this ash to the disposal system in the boiler room.

Automatic combustion-control equipment regulates the fires, maintains the output of the boilers, and holds the steam pressure fairly constant. Feed water is heated in open heaters, and delivered to the boilers by centrifugal pumps, the flow being controlled by individual feed regulators. Each boiler is likewise equipped with a high- and a low-alarm water column and soot blower. From the above it can be readily seen that the actual manual labor required in the normal operation of the boiler room is relatively small.

The engine room contains four steam-engine-generator sets and one Diesel engine set. These generate direct current at 115 and 230 volts for light and power, respectively. Each of these units has its individual oiling system, so trouble with lubrication or the unit itself must be a purely local condition.

The refrigerating plant has one engine-driven CO_2 compressor and three motor-driven compressors, all machines being direct connected. Brine- and water-circulating pumps, of which there are nine, are direct-connected, motor-driven, centrifugal machines, all of which makes for simplicity and efficient operation.

The ventilating system, with its motor-driven fans, air washers, indirect heaters, etc., is of substantial design. Ring-oiled bearings are used on the fans, and the motors are equipped with ball bearings, grease-packed, so that continuous service with a minimum of maintenance expense is expected. The ventilating equipment consists principally of 34 fans driven by direct-connected, variable-speed motors. These units are scattered with one or more fans in each of the four cellars, a group on the fourth floor and another group on the forty-third floor.



This entire switchboard, with its automatic speed and reversing controls for washing machines, is devoted entirely to laundry service. The laundry is an important consumer of four power services: steam, hot water, cold water and electricity. The engineer must deliver these services to the machines

The adequate installation of meters and gages will serve not merely as a routine guide of regular operation, but also to assure the highest economy at all times. A brief outline of the meter equipment follows: Starting in the boiler room, each pulverizer is equipped with an automatic recording coal scale, so that the coal can be weighed "as fired." This

Pipe Identification System

(Condensed from specifications)

Three-inch bands, with arrows indicating direction of flow, not more than ten feet apart on pipe (on under side of pipe for overhead pipe; otherwise as directed). Bands also on fitting flanges and valve bonnets as directed.

Service	Body Color	Band Color	Band Marking
Fire and sprinkler	Red	.....	.....
Gas piping (service d'p'ts)	Black	.....	.....
Compressed air, low pressure	Light gray	.....	.....
Compressed air, high pressure	Dark gray	.....	.....
Canvas-jacketed lines, (service departments)	White	As described under individual service	
Superheated steam	White	Orange	.....
Saturated steam, 175 lb	White	Yellow	175
Saturated steam, 100 lb	White	Yellow	100
Saturated steam, 40 lb	White	Yellow	40
Saturated steam, 5 lb	White	Yellow	5
Exhaust steam	White	Yellow	EXH.
Heating returns	White	Yellow	RET.
CO_2, h.p., including liquid lines	Black	Red	.....
CO_2, low temp. suction	Black	Red	L.T.
CO_2, main system suction	Black	Red	M.S.
CO_2, air-cooling system, suction	Black	Red	A.C.
Cold water, city meter, connecting piping	White	Light green	.....
City water supply direct from city meters	White	Light green	C.W.
Cold water to laundry	White	Light green	LAU.
Cold water to kitchen	White	Light green	KIT.
Cold water to barber shop	White	Light green	B.S.
Cold water from pump to high level hot water heater	White	Light green	H.L.
Cold water from pump to intermediate level hot water heater	White	Light green	I.L.
Cold water from pump to low-level hot water heater	White	Light green	L.L.
Hot water discharge and return of heaters	White	Dark green	As indicated for cold w'tr
Ice water (cork covering)	Black	Dark blue	H.L. and L.L. as for cold water
Air conditioning water, supply	Black	Light green	
Air conditioning, water, return	Black	Dark green	.....
Brine, low temperature	Black	Orange	.....
Brine, standard temperature	Black	Yellow	.....
Boiler feed, suction	White	Orange and yellow ($\frac{1}{2}$ and $\frac{1}{2}$)	SUCT.
Boiler feed, discharge	White	Orange and yellow ($\frac{1}{2}$ and $\frac{1}{2}$)	DIS.

Heaters (hot water and feed), muffler tank and blow off tank painted white and marked with black letters and numbers 2 in. high.

Building water supply tanks, etc., in 25th, 35th and 43rd floors, together with all uncovered piping, etc., in connection with them to be painted light gray. All these tanks to be marked with 2-in. high black numerals, as directed, indicating tank capacity, number, service, etc.

Balancing tanks for ice water and brine (cork covered) to be banded top and bottom with 2 in. wide bands of the identifying color listed for connecting pipes and marked with the service in 2-in. high letters.

shows up, from day to day, the fuel economy of the individual shifts in the boiler room and promotes competition among the plant operators.

The total quantity of water fed to the boilers is measured by a recording-integrating Venturi meter. Each boiler has two steam outlets, one for saturated and the other for superheated steam, each outlet steam line being equipped with a recording, indicating, integrating flow meter. That on the superheater line has a pen which records the steam temperature on the flow-meter chart. These flow meters are mounted on individual instrument panels on the boiler fronts together with CO_2 recorders and indicating draft gages.

With these meters, the water fed to the boilers can be checked against the steam generated. If account is taken of the water lost by blowing down boilers and the steam used by the soot blowers, a very simple check of the meter accuracy can be obtained.

Flow meters to record the quantity of steam used by the kitchen, laundry and barber shop are installed in the engineer's record office, each instrument being equipped with a recording pressure pen, so that any complaints regarding lack of steam or pressure drop can be instantly checked. There is also a recording pressure gage on the city water header, a recording back-pressure gage on the exhaust header from the engines and a recording thermometer in the engine room, giving outdoor temperatures.

The main switchboard in the engine room is equipped with watt meters to record the output of the steam engine-generating units and the Diesel unit. A master watt meter measures all electricity used for power, and a similar meter measures the total lighting load.

To register the kilowatt-hours of electricity used by the various services throughout the hotel, individual watt meters are connected to the different feeders and located behind the main switchboard. The electric meter equipment will permit a detailed allocation of the energy used by services and by departments.

Records are made at the New Yorker for two reasons: first to satisfy ourselves that we are operating most economically, and, secondly, to furnish the necessary cost data to the management so they can allocate the costs of the various services provided by the heat, light and power department.

The basic cost is that of steam, which, with the meters provided in the boiler room, is calculated daily. Saturated steam, generated by the boilers at a pressure of 175 lb., is passed through reducing valves and is used principally during the summer months by the laundry, kitchen and barber shop, each service being metered separately.

During the heating season, when the engine exhaust is insufficient, live steam from the saturated header is passed through reducing valves into the heating system, and the returns are measured by a condensate meter, to be mentioned later. The total quantity of high-pressure superheated steam used by the engines can be measured directly from the superheated-steam flow meters in the boiler room, as no other service is taken from this line.

The quantity of condensed steam from the heating system and hot-water heaters handled by the vacuum

pumps is measured by a condensate meter connected into the discharge from the pumps. Using the unit cost of steam as produced in the boiler room, it is a relatively simple matter to calculate the total and unit costs of these services.

In figuring steam costs, electricity is treated, in large part, as a byproduct and credited with all steam passing through the engines which is afterward used for other purposes.

Briefly, in a private plant such as this, the generation of electricity should be charged only with the heat loss of the steam in passing through the engines and any additional exhaust steam wasted to the atmosphere.

The total daily cost of all the water used in the building is obtained directly from the readings of the five city water meters fed from the street mains. Cost of hot and cold water used in the kitchen, laundry and barber shop is likewise obtained from separate meters on these services, using one basic cost of steam to calculate the additional cost of the hot-water service. Make-up water for the boilers is also calculated and charged against steam generation.

Since electricity is metered to the kitchen, laundry, elevators, bank, etc., as well as to the various concessions and stores, it is a simple matter to charge for this service.

Labor costs in operating the power plant are charged directly, according to where rendered, such as *boiler room, engine room, refrigeration,* etc. Maintenance labor costs throughout the building are charged according to where the mechanics are working; for example, to laundry, kitchen, guest rooms, plant, etc.,

There are, of course, other records kept to assist operation as well as for economic reasons, but those mentioned will give a general idea of their nature and use.

The Diesel generating set added to a steam power plant not only serves as a stand-by, but also has an important influence on the "heat balance," by preventing waste of exhaust steam.

The exhaust steam requirements of the building are mainly for: (1) heating the building during the heating season; (2) heating water for use in the laundry, kitchen, guest rooms and other parts of the building; (3) heating boiler-feed water; (4) reheating air in the air-conditioning apparatus during the summer months.

Items 2 and 3 (heating water) are fairly constant through the entire year, while item 1 (building heating) is non-existent in the summer, when item 4 (reheating conditioned air) is at a maximum.

The difference between the requirements of items 1 and 4 is such that in summer, generation of the entire electrical demand by steam engines would produce an excess of exhaust steam. This would have to be vented to the atmosphere, with a consequent heat loss. Operation of the Diesel to cut down or eliminate altogether the venting of exhaust steam will increase the thermal efficiency of the plant as a whole.

Emergency operation has been provided for in the power plant and throughout the building in many ways, even to what might be termed "small details."

In the boiler room extra coal holes in the sidewalk enable the plant to receive coal in the bunkers should the coal crusher and conveyor go out of service. While failure of this equipment would place an extra load on the pulverizers, and require increased vigilance of the boiler room crew, nothing more serious is anticipated.

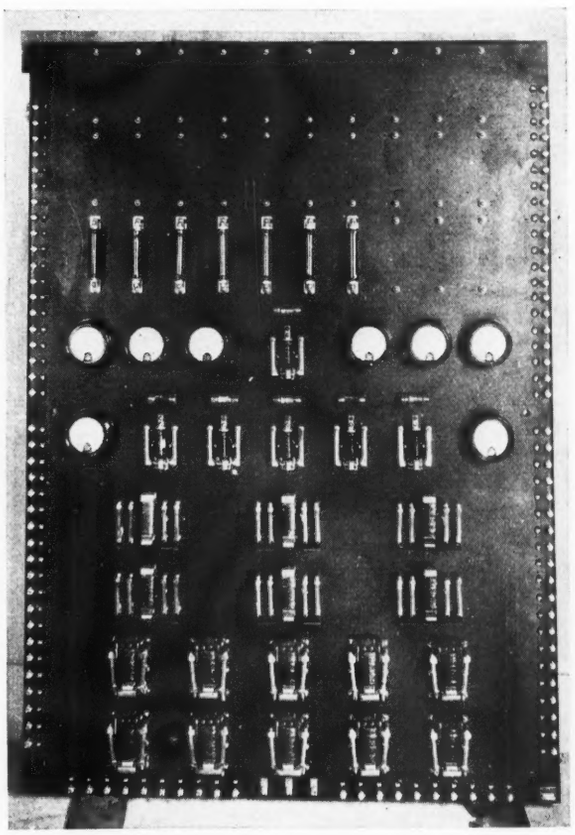
There is ample capacity in boilers, with a spare unit ready at all times. Two separate boiler feed-water lines of extra heavy brass pipe (one for emergency service) provide safety and flexibility.

Two centrifugal boiler-feed pumps, one turbine driven and the other direct connected to a motor, are assisted by a connection from the forty-third floor house tank to the emergency boiler-feed line.

While this may seem a roundabout way to get water into the boilers, it still makes possible the use of several house-service pumps for this duty if necessary, as the static pressure in the down-feed line from the 43rd floor house tank is over 200 lb. in the boiler room.

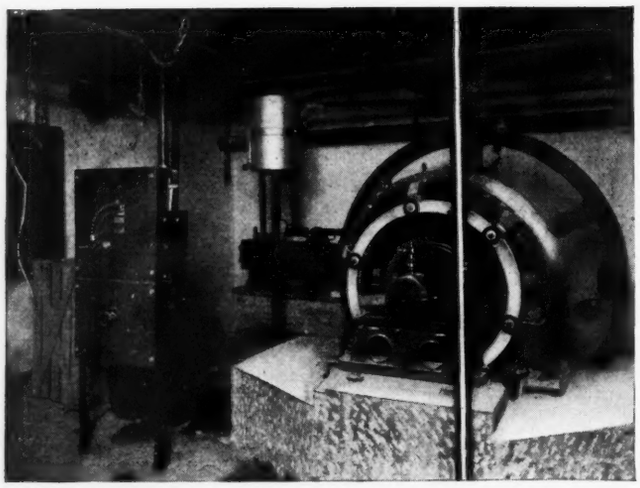
A loop steam header joins the engine and boiler rooms, half of the boilers and engine being connected to each side of the loop, with enough division valves so that any section can be cut out of service for repairs without interrupting the operation of the rest of the plant.

While the regular house-water-service pumps are motor driven, the "spare" is driven by a steam turbine. This unit, working with the steam - turbine - driven fire pump, gives ample reserve, as all pump discharge lines are cross connected for emergency. It is possible to feed from the 43rd floor house tank to the 35th floor tank and again from the 35th floor tank to low level tank on the 25th floor.



This signal board in the chief's office is a constant reminder of the fact that fire protection is one of the power services

The largest single water "customer," the laundry, is supplied from the street mains direct. In fact, all water used in the building from the fourth cellar up to and including the fourth floor comes direct from the city mains. This includes the kitchen, restaurants and public rooms; and reduces pumping to a minimum. In other words, all the water pumped to the house-service tanks on the 25th, 35th, and 43rd floors is used in the guest rooms. The water supply from the city mains feeds the building through five meters on 34th St., 35th St. and Eighth Ave., and should eliminate the "water - shortage" problem, especially since the city water suction tank of the house



Leakage difficulties caused by the use of CO_2 at high pressures as a refrigerant are minimized by welded piping

pump located in the fourth cellar has a capacity of 80,000 gallons.

Hot water for use throughout the building, including the laundry, kitchen, guest rooms, etc., is taken care of by ten large closed heaters, cross connected for emergency, nine being in use at all times, with one heater as a spare unit.

The CO_2 machines in the refrigerating plant are cross connected, so that it is possible to operate the air-conditioning or low-temperature systems should something happen to one of these units, by using one of the main refrigerating machines, one of which acts as a spare for this purpose. Brine, drinking water and air-conditioning water pumps are installed in duplicate.

Vacuum pumps on the heating system are installed in triplicate. The vacuum cleaning machines and pneumatic-tube vacuum machines are installed in duplicate. There are also two motor-driven air compressors, one for 100 lb. pressure air and the other for 30 lb. These are cross connected so that the 30-lb. air can be obtained at all times, since that pressure is required for thermostats.

This list of provisions for emergency operation could be extended to include what might be termed "minor" items, which, however, are important and have likewise been well taken care of.

There are a number of services which, while they seldom get out of order, are so important that it was deemed necessary to protect them with automatic alarm attachments. For example, a high-temperature alarm has been installed in the superheater outlet of each boiler. To prevent a shortage of water, as well as an overflow in the house-service tanks situated on the 43d, 35th and 25th floors, each tank is equipped with a high- and a low-water alarm. These also serve as a check on the regular operation of the house-service pumps, which are automatically controlled by tank switches. The ten ejector pumps are protected by high-water alarms on each sump.

Alarms likewise protect the Diesel engine. The fuel oil is fed to the engine by gravity from an auxiliary tank hung on the engine room wall; while lubricating oil flows by gravity from a similar tank. In case of low oil level in either tank an electric alarm is rung. Failure of the cooling water supply, as shown by excessive temperature of the circulating water discharge, rings another alarm.

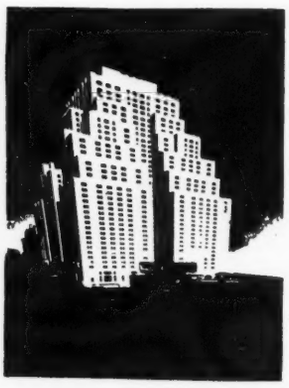
Another interesting feature is in connection with the piping layout of the New Yorker, which is quite extensive due to the many services, as well as the size of the building. To simplify the locating of the various exposed pipe lines of all kinds by the operating force, a system of pipe markings was worked out along the lines suggested by the piping identification committee of the A.S.M.E., as closely as these could be adapted to existing conditions. This system is summarized in the table on page 862.

Record forms and log sheets in use at the present time will undoubtedly be revised at a later date. Until all the meters and other instruments have been installed and operating schedules worked out it will be necessary to include several items which are too indefinite for permanent use.

Organization of the employees in the engineering department is similar to that found in the usual hotel. The daily power plant operation is divided into three shifts of eight hours; each in charge of a watch engineer. They are directly responsible to the assistant chief engineer, whose primary duty is to keep the plant operating and attend to the details of the plant maintenance. Each watch engineer has a boiler room engineer, fireman, boiler cleaners, etc., to carry on with. All maintenance is taken care of on the day watch, except in special cases.

Maintenance throughout the building, in addition to that in the power plant, is divided among the electricians, plumbers, elevator mechanics, carpenters, painters and machinists, each group being under a foreman reporting to the chief engineer. Most of this maintenance is of a routine nature or comes from "complaints" or work orders sent out by the various department heads or floor clerks.

In conclusion, allow me to state that we have a truly "isolated plant" to operate. As it is one of the few recently installed in New York City, as well as the largest, our problem is not only one of "operation," but also of justifying its installation. The plant as a whole is a radical departure from previously accepted standards, and it is expected that the economy obtained will lead to a revival of interest in the economic possibilities of such installations.



Power-Service Equipment in the New Yorker Hotel

General Data

Owner ..... The New Yorker Hotel Corp.
President ..... Mack Kanner
Architects ..... Sugarman & Berger
Mech. Eng. for the architects ..... B. H. Pisow
General contractor ..... Mack Kanner
General project manager ..... J. C. Sophian
Excavation contractor ..... Geo. J. Atwell Co.
Steam and heating equipment contractor ..... Raisler Heating Co.
Ventilating equipment contractor ..... Charles Hartmann Co.
Electrical equipment contractor ..... Jandous Elec. Equip. Co.
Elec. Eng., Jandous Electric Equip. Co. ..... J. N. Golding
Plumbing contractor ..... W. G. Cornell Co.
Mechanical, consulting engineers ..... Jaros & Baum
Diesel-engine and boiler-room, consulting engineer ..... H. W. Brooks
Electrical, consulting engineer ..... C. E. Smith
Plumbing, consulting engineer ..... A. E. Hansen
Size of plot, ft. ..... 197.5 x 175
Number of floors above street level 43
Number of basements 4
Total volume, cu.ft. 12,400,000
Volume above street level, cu.ft. 10,800,000
Number of rooms 2,500
Daily population of building (estimated) 30,000
Room guests 3,500
Employees 2,000

Boilers and Superheaters

Manufacturer of boilers ..... Combustion Eng. Corp.
Type ..... Heine cross-drum
Number of boilers 4
Number of tubes 322 (3-in.)
Length of tubes, ft. 20
Arrangement of tubes, staggered rows of 21 and 22 wide
Number of passes 3
Steam-making surface per boiler, sq.ft. 6,500
Working pressure, lb. gage 175
Installed by ..... Raisler Heating Co.
Superheaters ..... Superheater Co.
Square feet of heating surface 1,000
Ratio of superheater to boiler-heating surface ..... 1 to 6.5
Water columns ..... Reliance Gauge Column Co.
Feed-water regulators, Copes ..... Northern Equipment Co.
Blowoff tank, 48 x 72 in. ..... International Boiler Works Co.
Combustion-control equipment ..... Carrick Engineering Co.
Soot blowers, 6 units per boiler ..... Diamond Power Specialty Corp.
Safety valves, 4½ in., 2 per boiler ..... Consolidated Ashcroft Hancock Co.
Stop valves ..... Crane Co.
Blowoff valves, quick-closing ..... Yarnall Waring Co.
Blowoff valves, seatless-type ..... Everlasting Valve Co.
High-pressure and low-pressure valves ..... Crane Co.
Pressure reducing valves ..... Spencer Engineering Co.
Walkways and gratings ..... Madison Iron Works

Pulverized-Coal Equipment

Manufacturer ..... Riley Stoker Corp.
Cork in foundations ..... Korfund Co.
Number of pulverizers 4
Type ..... Atrita, unit
Capacity, lb. per hr. coal of quality given below, and crushed to go through 1¼-in. ring 5,500
Fineness, per cent, 80 through 200-mesh screen, 92 through 100-mesh screen and 98 through 50-mesh screen.
Capacity, lb. per hr., (coal with 9 per cent moisture) 4,250
Drive, direct, 50-hp., 1,150-r.p.m. shunt motors
Mfg. of motors and controllers ..... General Electric Co.
Flexible couplings ..... Falk Corporation
Pulverized-coal burners ..... Riley Stoker Corp.
Type ..... Special flare
Number of burners per boiler 1
Pounds of fuel per hr. per burner, max. 5,500 min. 1,500.
Furnace volume, cu.ft. 3,700
Ratio of furnace volume to boiler heating surface ..... 1 to 1.75
Proximate analysis of coal on which burners are rated:
- Volatile matter, per cent 17
- Fixed carbon, per cent 71
- Ash, per cent 7
- Moisture 5
- Heating value, dry basis, B.t.u. per lb. 13,500
- Fusing temperature of ash, deg. F., not less than 2,400

GUARANTEED PERFORMANCE OF BOILERS AND BURNERS

Boiler Rating, Per Cent	Flue Gas Temp., Deg. F.	CO_2 in Flue Gas, Per Cent	Comb. Boiler and Burner Eff., Per Cent	Coal per Boiler per Hr., Lb.	Power Input to Pulverizer Motor per Ton of Coal, Kw.-Hr.
100	450	13½	78	2,070	22.5
150	505	13½	78	3,100	16.5
180	525	13½	79	3,770	14.3
200	540	13½	77	4,250	13.2

Boiler Settings

Furnace walls, hollow, sectional-supported ..... M. H. Detrick Co.
Distance from lowest row of tubes to bottom of furnace, front 20; rear, 15.
Distance from lowest row of tubes to center line of burner, ft. 12
Furnace walls, cooling ..... Air
Secondary air supplied by natural draft and preheated in furnace walls
Primary air preheated by gas taken from highest point of furnace, through pulverizer by pulverizer blower.
Furnace volume, cu.ft. 3,700
Pounds of fuel burned per hour per cubic foot of furnace volume, at 200 per cent boiler rating 1.15
Firebrick ..... Henry Maurer & Sons
Sil-O-Cel heat insulation ..... Johns-Manville, Inc.

Stack and Breeching

Stack constructed by ..... Dover Boiler Works
Material used ..... Steel
Inside diameter at bottom ..... 7 ft. 10 in.
Inside diameter at top ..... 7 ft. 10 in.
Height above bottom of furnace ..... 520 ft.
Draft at bottom of stack, in. of water 3.6
Breeching constructed by ..... Sotter Bros. Co.
Fly-ash eliminator, vorticose type, located at top of stack ..... Dust Recovery, Inc.
Draft loss through furnace walls, boiler, breechings, stack, fly-ash eliminator, in. of water 3.4

Coal- and Ash-Handling Equipment

Manufacturer, coal-handling equipment ..... C. O. Bartlett & Snow Co.
Apron feeder, 24 in. wide
Drive, 3-hp., 1,150-r.p.m.-compound motor ..... Crocker Wheeler Elec. Mfg. Co.
Control, automatic from push button ..... Cutler-Hammer, Inc.
Gear speed reducer ..... Cleveland Worm & Gear Co.
Coal crusher, capacity, tons per hr. 25
Drive, 20-hp., 850-r.p.m. compound motor ..... Crocker Wheeler Elec. Mfg. Co.
Control, automatic from push button ..... Cutler-Hammer, Inc.
Magnetic separator ..... Magnetic Mfg. Co.
Belt conveyor, width, in. 16
Drive, 5-hp. 1,150-r.p.m. compound motor ..... Crocker Wheeler Elec. Mfg. Co.
Control, automatic from push button ..... Cutler-Hammer, Inc.
Gear speed reducer ..... Cleveland Worm & Gear Co.
Coal bunker, concrete, steel lined
Capacity, tons, (9 days supply in winter) 500
Automatic scales 4
Manufacturer ..... Richardson Scale Co.
Capacity, 200 lb. per drop, 3 tons per hr.
Ash-conveying system, type ..... Pneumatic
Manufacturers ..... Girtanner Eng. Corp.
Blower ..... General Electric Co.
Capacity, cu.ft. per min. 3,000
Drive, 40-hp., 3,500 to 4,000 r.p.m. shunt motor
Manufacturer ..... General Electric Co.
Control, manual ..... General Electric Co.
Ash receivers, steel, number 2
Capacity, cu.ft. ..... 950 and 450

Feed-Water Heaters With Oil Separators

Manufacturer ..... Swartwout Co.
Type ..... Open
Number 2
Size each, in. 48
Contents each, cu.ft. 123
Tray area, sq.ft. 51
Steam pressure, lb. gage 3

Boiler-Feed Pumps

Manufacturer ..... Worthington Pump & Machinery Corp.
Number 2
Type and size, centrifugal, 3 in.
Capacity, each, gal. per min. against 190-lb. head 340
Drive, one direct turbine, one direct motor
Manufacturer of turbine ..... Murray Iron Works Co.
Speed, r.p.m. 2,400
Horsepower 75
Steam separator on steam line to turbine ..... Swartwout Co.
Manufacturer of motor ..... Crocker Wheeler Elec. Mfg. Co.
Speed, r.p.m. 2,000
Horsepower 75
Control, manual ..... Cutler-Hammer, Inc.
Feed-water pump governors, Copes, ... Northern Equipment Co.

Steam Engines and Generators

Steam engine manufacturer ..... Skinner Engine Co.
Number 4
Type, horizontal, side crank, poppet valve, Unaflow with poppet auxiliary valves
Horsepower, Three 960 and one 640
Steam conditions, 165 lb. gage, 100 deg. F. superheat
Speed, r.p.m. 150
Back pressure, lb. ..... 0 to 3
Cylinder dimensions, three, 29 x 36 in; one, 25 x 32 in.
Exhaust pipe ..... M. W. Kellogg Co.
Size, in. 20
Steam exhaust muffler ..... International Boiler Works Co.

(Continued on the two following pages)

POWER-SERVICE EQUIPMENT IN THE NEW YORKER—*Continued*

Location, behind boiler No. 4
Size 60 in. diameter, 18 ft. long.
Oil separator ..... Kieley & Mueller, Inc.
Steam separators ..... Sims Co.
Lubricators on main engines ..... Madison Kipp
Engine throttle valves ..... Ludeman Bros.
Back-press. valve and exhaust heads. . Kieley & Mueller, Inc.
Cork in foundations ..... Korfund Co.
Generator manufacturer .... Crocker Wheeler Elec. Mfg. Co.
Type, direct-connected three-wire, compound, interpole, direct current.
Voltage, full load ..... 125 and 250
Capacity, kw. ..... Three 600, one 400
Guaranteed efficiency, 600-kw. units at ¾ load, 94 per cent; 400-kw. unit at ¾ load, 92.5 per cent.

GUARANTEED PERFORMANCE, 600-KW. UNITS

(Operating conditions, 165 lb. gage, 100 deg. superheat, 2 lb. back pressure.)

Output of Generator Kw.	Lb. of Steam Per Kilowatt-Hr.
150	31.5
300	26.9
450	26.8
600	27.8
750	29.8

GUARANTEED PERFORMANCE, 400-KW. UNIT

100	32.5
200	27.7
300	27.5
400	28.7
500	31.0

Diesel Engine and Generator

Engine manufacturer ..... I. P. Morris-De LaVergne, Inc.
Number 1
Type, vertical, four-stroke cycle, solid-injection.
Number of cylinders 8
Horsepower 530
Speed, r.p.m. 277
Cylinder dimension, in. 14½x18
Quantity of jacket water, full load, gal. per hr. 10,000
Use made of jacket water, heated by engine exhaust and goes to boiler feed and building service.
Cork in Foundation ..... Korfund Co.
Exhaust pipe, special riveted spiral, 12 in. diameter, from 3rd basement to roof, in same space with boiler stack.
Manufacturer ..... Naylor Spiral Pipe Co.
From muffler on engine to 3rd basement, exhaust pipe is 10-in. wrought iron.
Manufacturer of muffler .... I. P. Morris-De LaVergne, Inc.
Location of muffler, at engine.
Size of oil storage tank, gal. 2,900
Size of service oil tank, gal. 100
Location of oil storage tank, under engine room floor
Oil level indicator ..... Rochester Mfg. Co.
Lubricating-oil heater ..... Westinghouse Elec. & Mfg. Co.
Centrifugal purifier ..... Sharples Specialties Co.
Oil cooler ..... Schutte & Koerting Co.
Air filter ..... Reed Air Filter Co.
Pyrometer, on cooling water ..... Brown Instrument Co.
Air compressor ..... Ingersoll-Rand Co.
Capacity, 30 cu.ft. of free air, compressed to 250 lb.
Air-storage tanks, two, capacity cu.ft. of free air 475
Air compressor motor ..... Westinghouse Elec. & Mfg. Co.
Size, 5-hp.; speed, 1,750 r.p.m.; type, shunt.
Connected to compressor by ..... Short-center belt
Chain hoist, 1-ton capacity ..... Yale & Towne Mfg. Co.
Generator, manufacturer .... Westinghouse Elec. & Mfg. Co.
Type, direct-connected, three-wire compound-wound.
Voltage, full load ..... 125 to 250
Capacity, kw. 375
Quality of fuel oil on which engine performance is based: Baumé 24-28, B.t.u. per lb. 18,600.

Switchboard

Manufacturer ..... Empire Switchboard Co., Inc.
Number of panels, one section 18
Voltmeters ..... Weston Elec. Inst. Co.
Ammeters ..... Weston Elec. Inst. Co.
Watt-hour meters ..... Sangamo Electric Co.
Wattmeters, recording and indicating . . Esterline-Angus Co.
Circuit breakers, on switchboard . . . I.T.E. Circuit Breaker Co.
Circuit breakers, at generators—I.T.E. Circuit Breaker Co.
Field rheostats ..... Cutler-Hammer, Inc.

Refrigerating Plant

Manufacturer of compressors ..... Wittenmeier Mach. Co.
Number 2
Type, horizontal, slow-speed, single-cylinder, double-acting, side-crank.
Refrigerant ..... Carbon dioxide
Speed, r.p.m. ..... 85 to 105
Cylinder dimensions, in. 6½x24
Suction pressure, lb. gage 265
Exhaust pressure, lb. gage 882
Capacity, tons of brine cooling 120
Horsepower per ton of refrigeration per hr., steam engine, 40; motor, 37.
Compressor lubricating system .... W. M. Nugent & Co., Inc.
Drive, one machine ..... Steam engine
Manufacturer ..... Skinner Engine Co.
Type, horizontal, side-crank, poppet-valve, unaflow, with poppet auxiliary exhaust valves.
Throttle valve ..... Ludeman Bros.
Steam trap ..... Vance-Vetter Co.
Horsepower 200
Governor control of cut-off for all stated speeds, 165 lb., 100 deg. superheat steam, exhaust 3 lb. back pressure.
Manufacturer of motor and control .... General Electric Co.
Horsepower 185
Type, compound, mounted, directly on compressor shaft.
Type of control ..... Manual
Manufacturer, compressor, low temperature, Wittenmeier Mach. Co.
Number 1
Type, horizontal, single-cylinder, double-acting, side crank.
Refrigerant ..... Carbon dioxide
Speed, r.p.m. ..... 120 to 135
Cylinder dimensions, in. 3½x12½
Suction pressure, lb. gage 270
Discharge pressure, lb. gage 882
Capacity, tons of refrigeration per day 15
Horsepower per ton of refrigeration, per hr. 56
Drive, direct-connected, 35-hp., compound motor.
Manufacturer of motor and controller . . General Electric Co.
Type of controller ..... Manual
Manufacturer of compressor on air-conditioning system, ... Wittenmeier Mach. Co.
Number 1
Type, horizontal, duplex double-acting, side-crank.
Refrigerant ..... Carbon dioxide
Speed ..... 130 to 150
Cylinder dimensions, in. 5x16
Suction pressure, lb. gage 495
Discharge pressure, lb. gage 882
Capacity, tons of air, cooling capacity 166
Horsepower per ton of refrigeration, per hr. 29
Drive, compound motor mounted on crankshaft.
Manufacturer of motor and controller . . General Electric Co.
Horsepower 200
Speed, r.p.m. ..... 130 to 150
Type of control ..... Manual
Initial charge of CO_2 in refrigerating system, lb. 7,500
Manufacturer of condensers ..... Wittenmeier Mach. Co.
Number 2
Type ..... Double-pipe
Cooling surface, each condenser, 10 stands, 8 pipes high, 20 ft. long, of two 1¼-in. pipes.
Outlet water temp. deg. F., maximum 72
Condenser water used for building service.
Air-conditioning-water coolers, Baudelot type, 8 stands, 7,000 ft. of 1¼-in. pipe ..... Wittenmeier Mach. Co.
Raw-water agitator for ice making ..... Jos. Monticello Co.
Core sucker ..... Perfection Mfg. Co.
Ice-can hoist, ½ ton capacity ..... American Engineering Co.
Brine temperature regulator ..... Fulton Sylphon Co.
Cork insulation ..... Korfund Co.

Brine Pumps

Manufacturer ..... Chicago Pump Co.
Number 4
Type, horizontal centrifugal.
Capacity, two, 3-stage, 200 g.p.m., 125 lb. per sq.in. pressure; two low temperature, 2-stage, 75 g.p.m., 100 lb. per sq.in.
Type of drive, direct-connected shunt motor.
Manufacturer of motor and controller . . General Electric Co.
Horsepower, two, 30-hp., comp.; two, 15-hp., comp.
Speed, r.p.m. 1,750
Type of control ..... Manual

Heating and Ventilating System

Direct-heating equipment ..... Murray Radiator Corp.
Radiators, sq.ft. total, ... 103,000
Heating done by exhaust steam at 3 lb. pressure.
Radiator valves ..... C. A. Dunham Co.
Temperature regulators for radiators . . . Johnson Service Co.
Manufacturer, indirect heating, tempering stacks and reheaters ..... Bayley Mfg. Co.
Radiation, sq.ft. 19,000
Type of heaters ..... Chinook
Heating done by exhaust or live steam at 5 lb.

Heating System Vacuum Pumps

Manufacturer ..... Nash Engineering Co.
Number 3
Type ..... Jennings
Receiving tanks, two, each 270 gal. capacity, 20 lb. per sq.in. pressure to 10-in. vacuum.
Unions on lines to vacuum pumps ..... E. M. Dart Mfg. Co.
Drive, direct-connected shunt motors
Mfg. of motors and controllers ..... General Electric Co.
Horsepower 15
Speed, r.p.m. 1,150
Control type ..... Automatic

Air Filters

Air filters on ventilating system for the supply fans ..... Air Filtration Corp.
Number 9
Type ..... Oil washed
Total capacity, cu.ft. per min. 275,500

Air Washers

Air washers for conditioning air ..... Bayley Blower Co.
Number of washers 5
Type ..... Water spray
Total capacity, cu.ft. per min. 96,500
Air-conditioning equipment designed to maintain an inside temperature of 75 deg. F., 50 per cent relative humidity, when the outside temperature is 95 deg. and 50 per cent relative humidity.

Thermostat control on air washers....Powers Regulator Co.
Air-conditioning system valves.....Powers Regulator Co.

Cooled-Water Circulating Pumps

Service .....Baudelot coolers
Manufacturer .....Chicago Pump Co.
Number 2
Type, horizontal centrifugal, two-stage
Capacity, 900 g.p.m. each, 75-lb. pressure
Drive, direct-connected shunt motors
Mfg. of motors and controllers.....General Electric Co.
Horsepower 75
Speed, r.p.m. 1,750
Type of controller .....Manual

Air Washers, Cooled-Water Circulating Pumps

Manufacturer .....Economy Pumping Mach. Co.
Number 5
Type, horizontal, single-stage, double-suction, centrifugal
Capacity, g.p.m, 1, 320; 1, 216; 1, 180; and 2, 90:
Head, ft. 20
Drive, direct-connected shunt motors
Manufacturer of motors.....Westinghouse Elec. & Mfg. Co.
Horsepower, 2, 3; 1, 2; 2, 1½
Speed 1,150
Control, automatic .....Industrial Controller Co.

Ventilating Fans

Manufacturer .....Bayley Mfg. Co.
Number, supply 14
Capacity, cu.ft. per min. 372,000
Number, exhaust 18
Capacity, cu.ft. per min. 582,000
Motors on supply fans total 195 hp.
.....Westinghouse Elec. & Mfg. Co.
Control on supply fan motors .....Cutler-Hammer, Inc.
Circuit breakers .....I. T. E. Circuit Breaker Co.
Motors on exhaust fans total 291 hp.,
.....Westinghouse Elec. & Mfg. Co.
Control on exhaust fan motors .....Cutler-Hammer, Inc.
Circuit breakers .....I. T. E. Circuit Breaker Co.
Drive, ventilating fans, Texrope...Allis-Chalmers Mfg. Co.

SERVICE SUPPLIED BY FANS

Rooms	Fan Capacity, Cu.Ft. per Min. Supply	Exhaust
Ballroom and 8 private dining rooms...	35,000	33,000
Main dining rooms and tea room.....	23,000	19,000
Grill.....	20,000	15,000
Banquet hall.....	10,000	9,000
Barber shop.....	9,000	7,000
Main kitchen.....	50,000	55,000
Kitchen hood.....	.....	33,500
Kitchen storage.....	31,000	.....
Pantry.....	.....	1,500
Fourth basement.....	38,500	40,000
Third basement.....	28,000	.....
Second and third basements.....	.....	22,000
Main lobby.....	24,000	27,000
Bank.....	22,000	28,000
Fourth floor.....	10,000	8,500
Laundry.....	62,000	53,000
Laundry.....	.....	16,000
Toilet and bath rooms.....	.....	102,000 40,000 36,000
Boiler room.....	10,000	.....

Service-Water Heaters

Manufacturer .....Patterson Kelley Co.
Number 10
Type .....Closed
Capacity, g.p.h., 7, 12,000; and 3, 6,000
Size, 42 in. diameter 13 ft. long.

Hot-Well Pump

Manufacturer .....Gould Pumps Inc.
Number 1
Capacity, g.p.m. 150
Pressure, lb. per sq.in. 100
Drive, direct-connected, shunt motor
Mfg. of motor and controller.....General Electric Co.
Horsepower 25
Speed, r.p.m. 3,500
Type of control .....Manual

Drinking Water Pumps

Manufacturer .....Westco Chippewa Pump Co.
Number 3
Type, horizontal, centrifugal capacity, g.p.m.....50
Drive, direct-connected, shunt, motors
Manufacturer of motors and controllers
.....General Electric Co.
Horsepower 5
Speed 1,750
Type of control .....Manual

House Pumps

Manufacturer .....Worthington Pump & Mach. Corp.
Number .....3 and a spare
Type .....centrifugal
Capacity and head, high-rise, 300 g.p.m., 500 ft.; intermediate-rise, 600 g.p.m., 400 ft.; low-rise, 1,000 g.p.m., 300 ft.
Speed, r.p.m. 1,750
Drive, high-rise, 75-hp. comp. motor; intermediate-rise, 125-hp. comp. motor; low-rise 125-hp., comp. motor; all direct connected
Motor manufacturer .....Crocker Wheeler Elec. Mfg. Co.
Type of controller, float switch with high and low-water alarm
Controller manufacturer .....Sundh Electric Co.
Spare pump, 600 g.p.m., 500-ft. head; speed, 2,050 r.p.m., driven by a 125-hp. steam turbine
Turbine manufacturer .....Murray Iron Works Co.

Fire Pumps

Manufacturer .....Worthington Pump & Mach. Corp.
Number 1
Type .....Centrifugal
Capacity, g.p.m. 1,000
Head, ft. 550
Drive, direct-connected 250-hp., steam turbine
Turbine manufacturer .....Murray Iron Works Co.

Sump Pumps

Manufacturer .....Chicago Pump Co.
Number 10
Type .....Vertical, centrifugal
Capacity and speed, 2, 50 g.p.m., 72-ft. head, 1,140 r.p.m.; 6, 600 g.p.m., 65-ft. head, speed 1,140 r.p.m.; 1, 150 g.p.m., 75-ft. head, 1,140 r.p.m.; 1, 500 g.p.m., 75-ft. head, 1,720 r.p.m.
Drive, direct-connected compound motors
Manufacturer of motors ....Crocker Wheeler Elec. Mfg. Co.
Size, two 7½ hp., six 20-hp., one 10 hp. and one 25-hp.
Control, alternator-type float switch, ...Chicago Pump Co.
Automatic controllers .....Sundh Electric Co.

Air Compressors

Manufacturer .....National Brake & Elec. Co.
Number, 1 low-pressure, and 1, high-pressure
Capacity, cu.ft., free air per min.; low-pressure, 60; high-pressure, 150.
Discharge pressure, low pressure, 70; high-pressure, 100
Air used for air-conditioning and heating-system control and for cleaning.
Drive, low-pressure, 10-hp., 1,750-r.p.m. series motor; high-pressure, 30-hp., 1,750-r.p.m., comp. motor
Manufacturer .....Westinghouse Elec. & Mfg. Co.
Control, automatic .....Cutler-Hammer, Inc.

Meters and Instruments

Boiler feed-water, Venturi .....Builders Iron Foundry
Flow meters, steam ..... Cochrane Corp.
Flow meters, condensate .....Cochrane Corp.
Draft gages .....Hays Corp.
Co_2 recorders .....Hays Corp.
Flue-gas analyzer .....Hays Corp.
Pressure gages, steam recording.....Bristol Co.
Pressure gages, steam indicating.....Ashton Valve Co.
Pressure gages, water recording .....Bristol Co.
Indicating thermometers .....Taylor Instrument Co's.
Recording thermometers .....Taylor Instrument Co's.
Recording thermometers .....Bristol Co.
Temperature controls, excess superheat.....Bristol Co.
Pyrometers, on Diesel engine.....Brown Instrument Co.
Level indicator on Diesel oil tank.....Rochester Mfg. Co.
Liquid-level gages .....Liquidometer Co.
Water meters .....Worthington Pump & Mach. Corp.

Piping Work

High-pressure, steam, Van-Stone flanges
.....M. W. Kellogg Co.
Low-pressure steam .....Republic Iron & Steel Co.
Steam-pipe covering .....Johns-Manville Corp.
Brine piping and covering.....Wittenmeier Machinery Co.
Co_2 piping and covering.....Wittenmeier Machinery Co.
Plumbing piping, contractor.....W. G. Cornell Co.
Plumbing valves .....Fairbanks Co.
Unions .....E. M. Dart Mfg. Co.

Traps

High-pressure .....Vance Engineering Co.
Low-pressure .....C. A. Dunham Co.

Cork Insulation

In foundations .....Korfund Co.
On refrigerating equipment .....Korfund Co.

Elevators and Dumbwaiters

Manufacturer .....Otis Elevator Co.
Number of passenger elevators.....12
Number of service elevators 6
Speed ft. per min. 700
Capacity, lb. 3,000
Ballroom elevator, speed, 250 ft. per min.; capacity 5,000 lb.
Subway passenger elevator, speed, 100 ft. per min.; capacity 5,000 lb.
Freight elevators, number, 2; speed 200 ft. per min.; capacity 4,000 lb.
Bank elevator, speed 200 ft. per min.; capacity 2,000 lb.
Dumbwaiters, number, 4; capacity 300 lb. at 100 ft. per min.; 500 lb. at 80 ft. per min.
Passenger-elevator cabs .....The Tyler Co.

Vacuum Cleaning System

Manufacturer .....Spencer Turbine Co.
Number of units, 2, 42-in. cleaners, each connected to a 50-in. separator.
Drive, direct-connected Crocker-Wheeler, 20-hp motors.
Control, manual .....Cutler-Hammer, Inc.

Pneumatic-Tube System

Manufacturer .....Lamson Co.
Number, one duplex unit, each 63-in. Spencer turbine
Drive, direct-connected, Westinghouse, 40-hp. motors.
Control, manual .....Cutler-Hammer, Inc.

Miscellaneous Equipment

Floor grating and stairs in boiler room
.....Madison Iron Works
Gaskets .....Durabla Mfg. Co.
Telautograph system .....Telautograph Corp.
Fire alarm system.....Am. District Telegraph Co.
Watchman's system.....Am. District Telegraph Co.
Laundry, 60 motors total 196.5 hp.
Kitchen, 28 motors total 45 hp.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

GOVERNOR ROOSEVELT *of New York, in an article in the December issue of the "Forum," definitely declares himself in favor of government ownership and operation of Muscle Shoals, Boulder Dam and the St. Lawrence River power projects; writing that, "If so developed, they will remain forever as a yardstick with which to measure the cost of producing and transmitting electricity."*

* * *

A UNIQUE APPARATUS *for generating steam by gas, similar in principle to the oxy-gas flame used for cutting metal under water, has been developed in England whereby the gas is burned directly in the water to be heated, so that all the heat units are absorbed to produce steam. A steam generator resembling this one was constructed and operated in this country about twenty years ago, but it failed to become a commercial success.*

* * *

THE HIGHEST-POWERED *and largest commercial vessel built in American yards is now being constructed for the Dollar Line by the Newport News Shipbuilding & Dry Dock Company. Its turbine-electric drive will develop 26,500 shaft-horsepower, employing two 10,200-kw. turbine-generators.*

* * *

EXCEEDING *its output during September, 1928, by 41 per cent, the International Paper & Power Company system produced 383,347,000 kw.-hr. during the same month this year. More recently, a subsidiary, the Canadian Hydro-Electric Corporation made a new high output record for a single day by producing 7,927,364 kw.-hr.*

* * *

OCTOBER SALES *of mechanical stokers, as reported to the Department of Commerce by ten leading manufacturers in the industry, totaled 178 with 56,108 hp., as compared with 155 of 45,685 hp. in September and 100 of 27,219 hp. in October, 1928.*

National Power Show to Open Dec. 2 in New York City

Greatest Array of Equipment in History of Exposition to Be Shown by More Than 500 Exhibitors—Life-Size Displays and Export Day Among Features

OPENING on Dec. 2 at the Grand Central Palace in New York City, the National Exposition of Power and Mechanical Engineering will present this year the most extensive range of equipment ever shown in the eight years of the exposition's history. Practically every branch of machinery and apparatus in the power generation and mechanical engineering fields will be displayed by more than 500 exhibitors. Preparations are being made for an attendance well in excess of last year's 123,000.

The exhibits will range from fuels and combustion equipment to displays covering power transmission and application, machinery, materials, belts and belting equipment, instruments, tools and supplies, heating and ventilating, refrigeration and material handling devices. In addition, the latest developments in the application of power in the process industries will be shown at the National Power Show. There will be numerous exhibits relating to power generation, distribution and utilization as well as exhibits of various control and recording instruments and many others showing the possibilities of modern heating and ventilating.

A feature of the exhibits will be the many full-size displays. Complete boiler units of various types will be set up for inspection. All kinds of stokers and pulverized fuel equipment will be shown in model layouts. Turbines, generators, Diesel engines, pumps and electric motors of practically every variety will be on display. Coal and ash-handling equipment will be exhibited; one manufacturer going so far in this connection as to present a scene-in-action display showing complete operation of a hydro-jet system of ash removal. Another full-size exhibit will be that of a patent heat reclaimer.

Among the new apparatus to be presented at the Power Show are automatic valves and controlling systems. A model in operation will demonstrate a new method of cooling by the use of special towers. Many new and interesting designs will be shown in valves, meters, expansion joints, packing and accessories. A high-pressure pilot-operated steam trap of great capacity will be on display for the first time. There will be a new automatic acid feeder for water softening processes and a new automatic soot blower head. A unique exhibit will be that of a new contact cable, that closes a circuit without the aid of a switch by merely pressing the cable at any point. Visitors will be invited to inspect an unusual gear reduction unit, a new horizontal centrifugal and many other new devices.

Notable among the special features of the show will be Export Day, similar to that observed last year with gratifying results. Rapid strides made in the power and engineering industry abroad in recent years have been evidenced by an increased demand for American equipment. In view of this foreign interest and the fact that 1,118 executives and government officials representing 109 towns and cities in 36 foreign countries registered at the last National Power Show, a special Export Day will be set aside again this year.

Mine Modernizes Power Plant

Recent additions to the power plant of the Inspiration Consolidated Copper Company, located near Miami, Ariz., have modernized and increased the capacity of the plant. A new 12,180-sq.ft. Stirling boiler has been added to twelve 7,000-sq.ft. boilers already in use. Eight of these, including the new one, are oil-fired and operate under forced draft at a pressure of 214 lb. The new boiler, however, can be run at 400 lb. if necessary. Other equipment installed includes a boiler feed-water regulator and a Cochrane hot-process water softener with a capacity of 10,000 gal. an hour.

A new Wheeler duplex natural-draft cooling tower, 180 x 140 ft. at the base and 100 ft. high, has been installed at the plant, with a capacity of 12,000 g.p.m. A new 8-ft. self-supporting steel stack has also been constructed to take care of the increased plant installation.

Maximum load on the plant at present is 30,000 kw., of which 18,000 kw. is used for mining and smelting the ore, the remainder being consumed by the Salt River Valley Water Users' Association and the Phoenix street railway.

New York's Largest and Tallest Hotel Soon Ready for Occupancy

Modernism Embodied in 43-Story New Yorker and in Spirit of Men Who Created It—Completeness of Appointments and Equipment Makes It Virtually a Self-Contained Community

GROWING out of an excavation that was the wonder of all New York, the New Yorker Hotel has now reached the full flower of its 43 stories, and will soon be ready for occupancy. Modernism is the keynote of the building and its appointments, and modernism pervades the spirit and vision of the men who made it possible.

Construction on New York's largest and tallest hotel started back in June, 1928, when antiquated and dilapidated buildings on Eighth Avenue between 34th and 35th Streets were torn down and busy steam shovels started digging one of the biggest "holes" citizens of the city had ever gazed into. To provide for the enormous service requirements of

J. C. SOPHIAN
General Project Manager

the hotel, four basements were skeletonized in steel and concrete before the budding hostelry poked its head above the street level. From that point on it grew like "Topsy," until several months later a modernistic conception of steel and stone had attained a record height for hotels of 43 stories above the ground.

Then came the vast task of giving life to this mass with suitably modern equipment and furnishings. Two thousand five hundred rooms, each with bath, shower and an abundance of light and air, had to be decorated in the modern manner and outfitted with the latest hotel conveniences: radios, electric fans, servidors and running ice water. Several spacious dance and banquet halls, an enormous grill room, many dining rooms and the largest cafeteria in New York City were to be luxuriously appointed. Modern kitchens with separate cold-storage rooms for various foodstuffs had to be installed. An up-to-date electric laundry—the largest hotel laundry in the world, with a capacity of 35,000 lb. of wash daily—had to be located in one of the sub-basements. Twenty-three elevators, many with automatic signal control and self-leveling devices, were to be installed. Barber shops,

MACK KANNER
President of the New Yorker Hotel Corporation

a beauty parlor and stores of every variety were planned to make this hotel virtually a self-contained community. Even a tunnel connecting the building with Pennsylvania Station has been constructed. All these at a total cost of $22,500,000, for the comfort and convenience of modern man.

Of the engineering equipment much has been written on preceding pages of this issue, but certain installations will bear additional mention here, namely:

H. W. BROOKS
Associated Consulting Engineer

the generating plant, using pulverized-coal, steam and Diesel engines, which supply steam and electricity for the entire building; the refrigerating systems, with a combined daily capacity of 255 tons, and the air-conditioning installation for the ball rooms, banquet halls, dining rooms, public halls and lobby.

Many outstanding personalities are connected with the accomplishment of this paramount creation. First comes Mack Kanner, president and builder of the New Yorker Hotel. More than anyone's else, his vision and executive ability was responsible for successful fruition of the project. Mr. Kanner has had vast experience in the construction and operation of public buildings. Besides being president of the New Yorker Hotel Corporation, he is president of the Hotel Belvedere Corporation, the Meridan Building and the Meridan Securities Corporation.

Next in line is J. C. Sophian, general project manager, who has had full responsibility for administration and coordination of the innumerable elements of the project. Recognition is also due

B. H. PISOW
Mechanical Engineer

B. H. Pisow, mechanical engineer for Sugarman & Berger, and H. W. Brooks, associated consulting engineer, for their work on the installation of the plant equipment. Much credit for the design and effectiveness of the building is due Sugarman & Berger, architects.

To Warren D. Lewis, chief engineer of the New Yorker Hotel, whose picture appears on page 860 of this issue, goes the honor of being intrusted with the plant operation of New York's largest hotel. Mr. Lewis left his position as assistant chief engineer of the Metropolitan Life Insurance Building to aid in the installation of power plant equipment in the New Yorker, and will now carry on with its operation.

Future plans call for the erection of office and other buildings in the square bounded by Eighth Avenue, Ninth Avenue, 34th and 35th Streets. In all probability these buildings will be supplied with power and light from the plant of the New Yorker Hotel.

John A. Stevens, Consultant, Dies

John A. Stevens, consulting engineer and honorary chairman of the A.S.M.E. Boiler Code Committee, died Nov. 18 at his home in Lowell, Mass., after a long illness. He was 61 years old.

Born at Galva, Ill., Mr. Stevens received his education at the Saginaw, Mich., high school and the University

John A. Stevens

of Michigan. After three years' apprenticeship to the machinist's trade, he served as an engineer on a number of Great Lakes' steamers, and won an unlimited engineer's license for ocean steamships at the age of 27. In 1896 he left marine work and became chief engineer of the Merrimac Manufacturing Company, of Lowell, Mass. During the thirteen years he spent in this position, Mr. Stevens practically rebuilt the entire steam plant at Lowell and at the same time superintended the power departments in the company's southern mills.

He resigned his position with the Merrimac company in 1909 and spent three months in Europe, gathering special information on steam boilers, steam turbines and condensers. On his return he opened an office as general consulting engineer, specializing on light, heat and power work. Mr. Stevens also did some original work in the line of invention, obtaining eight patents on water tube boilers as well as on the American steam superheater. He was also co-inventor of the Stevens-Pratt boiler, which is especially designed for large central station service.

He was probably best known to the public through his connection with the preparation of steam boiler standardization codes. He was a member of the original Massachusetts Board of Boiler Rules, representing the "boiler-using" interests. A past vice-president of the American Society of Mechanical Engineers, he served as chairman of the A.S.M.E. Boiler Code Committee for fourteen years, at the end of which he was appointed honorary chairman of the committee.

Coming Conventions

American Institute of Electrical Engineers. District meeting at Chicago, Ill., Dec. 2-4. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting at New York, N. Y., Dec. 2-6. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Society of Refrigerating Engineers. Twenty-Fifth Anniversary Meeting at Hotel Pennsylvania, New York City, Dec. 4-7. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

International Heating & Ventilating Exposition. Commercial Museum, Philadelphia, Pa., Jan. 27-31, 1930. Manager, C. F. Roth, Grand Central Palace, New York City.

International Congress for General Mechanics at Liege, Belgium, Aug. 31 to Sept. 7, 1930. For information address Alb. Schlag, 4 Place Saint-Lambert, Liege, Belgium.

National Electric Light Association. Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

National Marine Engineers' Beneficial Association. Annual convention at Hotel Barlum, Detroit, Mich., the week of Feb. 10, 1930. Secretary, A. L. Jones, 9th St. and Mount Vernon Place, N. W., Washington, D. C.

Jack Armour Dies After Long Illness

John W. (Jack) Armour, known by power engineers all over the country as entertainer par-excellence, died Nov. 15 at his home in Brooklyn, N. Y., after a

Jack Armour

long illness. He was born in Brooklyn, Oct. 8, 1856.

As a young man Jack Armour entered the printing trade with a firm known as the Gray-Green Company, where he learned type setting. After serving his apprenticeship, he joined the American Bank Note Company and worked with them for nearly eighteen years as a compositor. One of the papers he worked on during that time was the *Engineering & Mining Journal*, now a McGraw-Hill publication, which was printed for some years by the American company.

Always somewhat of a wag, Jack Armour left the printing trade to become an entertainer. In 1902 he joined the staff of the Hill Publishing Company as a representative of *Power* at conventions and meetings, where his inexhaustible fund of stories was a source of keen delight to engineers attending. He continued in that work until his retirement on account of ill health in 1923. So well did he uphold the traditions of his ancient profession that his name became almost synonomous with that of *Power*, and at one time no power engineers' convention was considered complete without him.

PERSONALS

PRESIDENT HOOVER has been asked to serve as honorary chairman of the American Committee of the World Power Conference. The invitation was extended by H. J. Pierce, vice-chairman of the committee.

JAMES S. ARNOLD, secretary of the Pennsylvania Industrial Board, has been elected an associate member of the National Board of Boiler and Pressure Vessel Inspectors. A life honor, this appointment was conferred for the first time by the board in appreciation of Mr. Arnold's efforts in the interest of uniform regulations for steam boilers throughout the country.

J. FRANK MCLAUGHLIN, who on Sept. 25 succeeded William E. Wood as president of the Virginia Electric & Power Company, has been elected vice-president of the Stone & Webster Service Corporation, of Boston. Jack G. Holtzclaw, formerly president of the Gulf States Utilities Company, has been appointed to take Mr. McLaughlin's place as president of the Virginia company. Thomas P. Walker, vice-president in charge of operation of the Virginia company, succeeds Mr. Holtzclaw as president of the Gulf States company.

MAXWELL ALPERN, president of the American Engineering Company, and Mrs. Alpern are departing shortly for a trip to Europe.

MARTIN FRISCH, formerly engineer in charge of development for the Combustion Engineering Company, is now in charge of engineering in the furnace and pulverizer division of the Foster Wheeler Corporation. During the past

eight years Mr. Frisch has had intimate contact with many of the outstanding power plant developments of the country.

JOHN L. MCCULLOUGH, for the past six years engaged in steam sales with the Allegheny County Steam Heating Company, is now associated with Felix A. Gunther, of Pittsburgh, Pa., in automatic temperature control work.

R. H. PINKLEY and G. G. POST have been appointed vice-presidents of the Milwaukee Electric Railway & Light Company. Mr. Pinkley was formerly connected with the Union Electric Light & Power Company, of St. Louis. Mr. Post is widely known in the central station industry as an authority on power plant and distribution problems.

HENRY B. BRYANS, formerly assistant general manager of the Philadelphia Electric Company, has been elected vice-president of that company.

A. P. M. FLEMING, of the Metropolitan-Vickers Electrical Company, has been appointed honorary secretary for England for a two-year term by the board of directors of the American Institute of Electrical Engineers. Mr. Fleming was formerly associated with the Westinghouse company at Pittsburgh.

BUSINESS NOTES

BABCOCK & WILCOX COMPANY, New York City, will henceforth be sole distributors of Thermix air preheaters for boiler service. The Prat-Daniel Corporation will continue to furnish air heaters for other applications.

BARNES MANUFACTURING COMPANY, Mansfield, Ohio, denies the rumor that it has merged with the Jaeger Machine Company. It will manufacture certain pumps for the Jaeger company, but there is no interlocking directorate, nor is any planned by the companies.

SULLIVAN MACHINERY COMPANY, Chicago, Ill., has recently completed an addition to its plant at Michigan City, Ind., where a larger volume of production will take care of the increased demand for its products.

TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., announces the formation of a new company, the A. G. Electric Manufacturing Company of Seattle, Wash., successor to the A. G. Manufacturing Company, in which the Trumbull company has secured a controlling financial interest.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has recently appointed the Harris Pump & Supply Company, 319-21 First Ave., Pittsburgh, Pa., as its high-temperature cement dealer in the Pittsburgh territory.

FULLER LEHIGH COMPANY, Fullerton, Pa., announces the opening of a new branch office at 703 Traction Bldg., Cincinnati, Ohio, under the direction of H. E. Martin.

KUHLMAN ELECTRIC COMPANY, Bay City, Mich., announces the appointment of Frank C. Fassett, 15 East Jackson St., Phoenix, Ariz., as its representative in that territory.

With the Society Sections

A. S. M. E., Ontario Section. Meeting, Dec. 6, Galt, Ont., at 8 p.m. Subject: "Vertical Air Compressors," by George Oman of the Babcock-Wilcox & Goldie-McCulloch Company. A trip through the Babcock plant in the afternoon and dinner in Galt will precede the address in the evening.

A. S. H. & V. E., Boston Chapter. Meeting, Dec. 9. Subject: "Recent Development in the Control of Direct Steam Heating," by Webster Tallmadge, steam specialist, of New York City.

A. I. E. E., New York Section. Power Group Meeting, Dec. 9, Engineering Societies Building at 7:30 p.m. Subject: "Power System Connections."

Power Transmission Association. Annual meeting at the Commodore Hotel, New York City, Dec. 4, at 10 a.m. The meeting will include a luncheon and a conference of pulley manufacturers in the afternoon.

TRADE CATALOGS

STOKERS — A new catalog describing the Green natural-draft chain-grate stoker has just been published by the Combustion Engineering Corporation, 200 Madison Ave., New York City. Among the interesting features of the illustrated bulletin are tabular data on three typical evaporative tests, and drawings showing the application of this stoker to various types of boilers.

PUMPS—An extensive catalog covering horizontal, vertical and heating pumps has just been issued by the Chicago Pump Company, 2336 Wolfram St., Chicago, Ill. Profusely illustrated, the publication contains 200 pages of pump description, application, engineering tables, specifications and a special section on useful information.

BLOWERS — Bayley Blower Company, 732-50 Greenbush St., Milwaukee, Wis., has recently published the following bulletins: 29-P, describing the Plexiform fan; 29-B, on the type B shaving exhaust fan; 29-C, describing the Chinookfin heater; 29-A, on the Turbo air washer and conditioner.

HOPPERS — Folder No. 15, recently issued by the Hahn Engineering Company, Lancaster, Pa., describes sectional cast-iron hoppers lined with high-temperature refractories for receiving hot or quenched ashes from grates, stokers, pulverized-fuel burners and industrial furnaces.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.15 @$2.50
Kanawha	Columbus	1.30 @ 1.60
Smokeless	Cincinnati	2.00 @ 2.25
Smokeless	Chicago	2.00 @ 2.25
S. E. Kentucky	Chicago	1.30 @ 1.60
Steam	Pittsburgh	1.50 @ 1.80
Gas Slack	Pittsburgh	1.00 @ 1.15
Big Seam	Birmingham	1.25 @ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$3.00
Barley	New York	1.35@ 1.50

FUEL OIL

New York—Nov. 21, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Nov. 12, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.596 per bbl. or 42 gal.; 26@28 deg., $1.646 per bbl.; 28@30 deg., $1.696 per bbl.; 30@32 deg., $1.746 per bbl.; 32@36 deg., gas oil, 5.026c. per gal.; 37@40 deg., distillate, 5.748c.

Pittsburgh—Nov. 12, f.o.b. local refinery, 30@34 deg., fuel oil, 4.87½c. per gal.; 36@40 deg., 5.12½c. per gal.

Philadelphia—Nov. 15, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati — Nov. 12, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Nov. 16, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 95c.@$1.00 per bbl.; 30@32 deg., $1.20 per bbl.

Boston—Nov. 18, tank-car lots, f.o.b., 12@14 deg., Baumé 4.25c. per gal.; 28@32 deg., 5.5c. per gal.

Dallas—Nov. 16, f.o.b. local refinery 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., San Francisco—State Harbor Comn., received lowest bid for reconstruction and additions to cold storage terminal from W. Williamson, 320 Market St., $16,452, also refrigeration equipment, etc., from Baker Ice Machine Co., 2459 East 14th St., Oakland, $28,255.

Conn., New Haven—H. B. Hunt, 115 Townsend Ave., Morris Cove, is having preliminary sketches made for the construction of a 5 story apartment building including electric refrigeration system, oil heating system, elevators, etc. here. W. R. Shiner, 152 Temple St., New Haven, is architect.

Kan., Hartford—City will soon award contract for waterworks improvements including pump house, 100 g.p.m. triplex pump, etc. Shockley Engineering Co., 800 Graphic Arts Bldg., Kansas City, Mo., is engineer.

Md. Baltimore—J. A. Gallagher, 3904 Canterbury Rd., plans the construction of an 8 story apartment building at 2500 Block north Charles St. Estimated cost $1,000,000. Architect and engineer not selected.

Md., Baltimore—Investment Construction Co., c/o L. T. Rouleau, Investment Bldg., Washington, D. C., Archt., is having plans prepared for an 8 story apartment building including steam heating system, etc. at 108-114 West University Parkway. Estimated cost $1,000,000. W. Ganter & Associates, Knickerbocker Bldg., are associate architects.

Md., Baltimore — Mayor and City Council, City Hall, will receive bids until Dec. 4, for the construction of a pumping station at Underwood Rd. and Spring Lane. E. G. Rost, Municipal Bldg., is engineer.

Mass., Allston (Boston P. O.)—Gold Brand Confectionery Co., 75 Beverly St., Boston, awarded contract for addition to boiler room and loading platform, here, to B. Steinberg, 6 Beacon St., Boston. Estimated cost $40,000.

Mass., Amesbury — Merrimac Hat Co., Merrimac St., awarded contract for the construction of a boiler house and heating plant to L. E. Locke Co., Bay State Bldg., Lawrence. Estimated cost $40,000.

Mich., Detroit — Dept. of Water Supply, awarded contract for the construction of a booster plant in connection with waterworks to W. E. Wood Co., 2701 Union Trust Bldg. Estimated cost $15,960.

Mich., Detroit — Public Light Commission, East Atwater St., is having plans prepared for the construction of a 2 story substation on Greenfield Ave. Estimated cost $60,000. Smith, Hinchman & Grylls, 800 Marquette Bldg., are architects.

Mich., Detroit—Wayne County, c/o Road Commission, 3800 Barlum Tower, awarded contract for a 1 story, 128 x 434 ft. airport hangar, including separate power plant and heating tunnel at Goddar and Middle Betts Rds. to Gallagher-Fleming Co., 6500 Epworth Blvd.

Mich., Owosso — American Malleable Co., Michigan Ave., is having plans prepared for the construction of loading docks, also warehouse for foundry products on Shiawasse St. Estimated cost $50,000. Private plans.

Mo., St. Louis—McKelvey-Carter & Co., 3800 West Pine Blvd., will build an 8 story apartment and stores building including steam heating system, etc., at Delmar and Kingshighway Blvd. Estimated cost $600,000. Work will be done by owners forces.

N. Y., Brooklyn—Rubel Coal & Ice Co., 937 Fulton St., plans addition to ice plant at India Wharf and Conover St. Estimated cost $40,000. H. J. Nurick, 44 Court St., is architect.

N. Y., Buffalo—The Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, plans the construction of a cold storage warehouse here.

N. Y., Glendale—Knickerbocker Ice Co., 41 East 42nd St., New York, had plans prepared for the construction of an ice plant at Proctor St. and Edsall Ave. here. Private plans.

O., Cleveland—Dept. of Public Welfare, H. H. Griswood, Dir., had plans prepared for the construction of a cold storage plant, etc. at Hauthendon Farm, Cleveland State Hospital. Estimated cost $93,000. T. R. Ridley, Ohio Hartman Bldg., Columbus, is architect.

O., Cleveland—Western Reserve University, 10940 Euclid Ave., awarded contract for the construction of a coal and ash handling plant to include 21 x 57 ft. pit, and tunnel 132 ft. long, coal and ash handling equipment, etc., on Cunningham Dr. to Masters & Mullen Construction Co., 4900 Euclid Ave. Estimated cost $40,000.

Okla., Tulsa—J. J. Harde, Oklahoma City, plans the construction of a public market including refrigeration plant, loading docks, switch tracks, etc., at 11th and Elgin Sts., here. Estimated cost $400,000. Architect and engineer not selected.

Pa., Erie—Warner Bros., Inc., 321 West 44th St., New York, N. Y., is having plans prepared for the construction of a 13 story theatre, store and apartment including refrigeration room, etc. at 10th and Sassafrass Sts. Estimated cost $1,500,000. Rapp & Rapp, 190 North State St., Chicago, Ill., are architects.

Tex., Brownsville—Cameron County Improvement Dist. 14, L. P. Stover, will receive bids until Dec. 12, for the construction of irrigation project including booster unit, etc. Estimated cost $1,000,000. W. E. Anderson, San Benito, is engineer.

Tex., Raymondville—Arledge Bros., Rochester, plans the construction of a 35 ton ice and cold storage plant and ice cream factory. Estimated cost $75,000. Private plans. Machinery and equipment for complete plant will be required.

Tex., San Antonio—Woodmen of the World, c/o W. A. Fraser, Pres., W. O. W. Bldg., Omaha, Neb., is having preliminary plans prepared for the construction of a central heating plant at local W. O. W. Hospital, North New Braunfels Ave., here.

Tex., San Perlita — L. A. Brown, Lazana, will build an electric light plant here. Most of work will be done by day labor. Also plans a 20 ton ice and cold storage plant. Estimated cost $40,000 and $30,000 respectively. Private plans. Machinery and equipment for ice plant, including coolers, cutter machine, electric unit, etc., will be required.

Wash., Mount Vernon — City Commission, plans the construction of a new sewage system in downtown section of city to include two pumping stations, pumps, etc. A. H. Dimock, Empire Bldg., Seattle, is engineer.

Wash., Tacoma—City received lowest bids for the substructure or a portion of the tailrace for the Cushman power house No. 2, also highway to carry Olympic highway over tailrace from Ward Construction Co., Tacoma. $219,940.

Equipment Wanted

Circuit Breakers—Philadelphia, Pa.—Treasury Dept., Washington, D. C., will receive bids until Dec. 6 for furnishing and installing circuit breakers, etc., on D.C. generator switchboard at U. S. Mint here.

Circuit Breakers, etc.—Wellington, N. Z.—Dept. of Public Works and Tenders Board will receive bids until Jan. 28 for three 50 kv. oil immersed circuit breakers complete and spares.

Electrical Equipment—Jacksonville, Fla.—City Commission, F. M. Valz, Chn., will receive bids until Dec. 9 for electrical equipment including storage battery, 333 kva. transformers, miscellaneous lot of switchboard equipment, etc., for South Jacksonville substation.

Engine—Malden, Mass.—M. C. Myers, 20 Wadsworth St., plans to purchase a 45 to 60 hp. steam engine, belt drive.

Fuse Switches—Los Angeles, Calif.—Purchasing Dept., City Water & Power Bureau, will receive bids until Dec. 5 for one 1,800 Mathews fuse switches, type "O.K." 7,500 v. 100 amp. (without fuse pullers).

Generator Set—Boston, Mass.—City Hospital Dept., plans to purchase a new engine generator set for power house on Albany St.

Lock Gate Operating Machinery—Kittanning, Pa.—U. S. Government Engineers, J. N. Martin, Ch. Clk., Keenan Bldg., 7th and Liberty Sts., Pittsburgh, will receive bids until Dec. 2, for lock gate operating machinery for dam and abutments, Lock No. 7, dam 916 ft. long.

Motors — Detroit, Mich. — Dept. of Water Supply, will receive bids until Dec. 4, for furnishing and installing two 500 hp. and one 150 hp. electric motors synchronous type for centrifugal pumps at Waterworks Park.

Pump and Motor—Spokane, Wash.—City, C. T. Bogart, Purch. Agt., will receive bids until Nov. 29 for a 3,800 g.p.m. pump and 250 hp. motor and starting equipment for proposed waterworks improvements.

Pumps, Engine and Generator—Hollis, Okla.—City, C. Thompson, Clk., will receive bids until Dec. 4 for four motor driven centrifugal pumps, one 120 hp. Diesel engine and generator for proposed waterworks improvements. $48,000.

Pumps and Motors, etc.—Franklin, Neb.—City will soon readvertise for bids for two pumps and motors, etc., for proposed waterworks improvements. Former bids rejected.

Refrigeration Equipment, etc.—Ingersoll, Ont.—Bigham Ltd., R. G. Bigham, Mgr., Thames St., plans the installation of refrigeration equipment, etc., for recently acquired plans.

Industrial Projects

Ind., Connersville — Corman-Aircraft Co., awarded contract for the construction of an airplane factory and power plant to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $150,000.

Mass., Leominster—DuPont Viscoloid Co., 511 Lancaster St., awarded contract for the construction of a glass plant to Wiley & Foss, 215 Central St., Fitchburg. Estimated cost $1,000,000.

Minn., Sleepy Eye — Midwest Canning Co., c/o E. Rader, will soon receive bids for superstructure of a group of buildings, including 65 x 400 ft. warehouse, 88 x 170 ft. factory, 88 x 120 ft. retort building, 30 x 71 ft. power house, etc. Estimated cost $400,000.

Mich., Detroit—Advance Stamping Co., 5712 12th St., awarded contract for a 2 story, 65 x 140 ft. stamping plant on Lyndon Ave. to Hoffman Construction Co., 7535 West Warren Ave. Estimated cost $50,000. Miscellaneous equipment for the manufacture of light metal stampings will be required.

Mich., Kalamazoo—Paper Products Mfg. Co., East Michigan Ave., is having plans prepared for the construction of a 2 story, 120 x 126 ft. factory. Estimated cost $90,000. Private plans. Machinery and equipment for the manufacture of paper products will be required.

Mo., St. Louis — Dubinsky Realty Co., 504 Wainwright Bldg., awarded contract for a 1 story, 75 x 130 ft. spring factory at 3133 Washington Ave. to Fischman & Harris, Inc., 629 Chestnut St. St. Louis Spring Co., 3135 Washington St., lessee.

O., Cleveland — Sinclair Automobile Service Corp., c/o H. L. Nelson, 2540 West 22nd St., Chicago, Ill., awarded contract for a group of buildings including 27 x 120 ft. service station, 27 x 256 ft. auto repair shop, and 100 x 115 ft. wash and boiler house, etc. at 7404 Euclid Ave. here, to J. E. Christian Co., 1307 St. Clair Ave. Estimated cost $150,000.

O., Cleveland—Wheeler Metal Products Co., E. F. Hoflinger, Treas., 1637 Collamere Ave., awarded contract for a 1 story, 80 x 300 ft. factory to A. A. Lane Construction Co., 1869 East 55th St. Estimated cost $150,000.

O., Toledo—Electric Auto Lite Co., Champlain and Mulberry Sts., awarded contract for a 1 story, 200 x 625 ft. factory to H. J. Spieker, 1418 Elm St. Estimated cost $1,000,000.

O., Toledo — Shell Petroleum Corp., Shell Bldg., St. Louis, Mo., will soon receive bids for the construction of a marine bulk plant, including facilities for loading and unloading boats and cars, etc., here. Estimated cost $400,000. Private plans.

Ore., Portland — Laher Auto Spring Co., 31 North 15th St., awarded contract for the construction of a 1 story, 100 x 100 ft. factory at 15th and Davis Sts. to Reimers & Jolivette, Railway Exchange Bldg. Estimated cost $50,000.

Pa., Lebanon — Lebanon Steel Foundry Co. awarded contract for the construction of a 1 story, 183 x 260 ft. foundry to C. H. Foulkrod Co., Philadelphia. Estimated cost $250,000.

Tex., Jacksonville—Newton & Wallace Gin Co., Inc., plans the construction of a cotton gin plant, 50 bale, probably electrically driven. Estimated cost $40,000. Private plans.

Tex., San Antonio—Indiana Oil & Gas Co., subsidiary of Graybury Oil & Gas Co., Graybury Bldg., J. W. Choate, is having plans prepared for the construction of an oil refinery. Estimated cost $1,000,000. Hope Engineering Co., 149 Broadway, New York, N. Y., is engineer. Machinery and equipment will be required.

Wash., Bellingham—St. Paul & Tacoma Lumber Co., plans to expend $200,000 for construction program to include electrically operated sawmill, planing mill and shingle mill.

Ont., Hamilton—Coffield Washer Co., 80 Park St. N., awarded contract for the construction of a 1 story, 60 x 300 ft. factory on Niagara St. to Frid Construction Co., 6 Hughson St. N. Complete machinery and equipment for the manufacture of electric washing machines will be required.

Ont., Ojibway — Canadian Steel Corp., Ltd., W. B. Berley, Pres., plans the construction of a tin plate mill, and plant for galvanizing black sheets, also power house. Estimated total cost $2,500,000.

Que., Farnham—Barry, Ostlere & Shepherd, Kirkcaldy, Scotland, is having plans prepared for the construction of a factory for the manufacture of linoleum here. Estimated cost $2,000,000. I. M. Robertson, 1017 Keefer Bldg., Montreal, Que., is architect.